This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com

UC-NRLF
C 2 674 439

CROWN
GORES
VANES
SPRING
2
3
4
5
SUSPENSION LINES
OF SEAMS
DIAGONAL SEAM
DIRECTION OF WARP PARALLEL TO DIAGONAL SEAM
C OR No 3
B PANEL OR No 2 SECTION
A PANEL OR No 1 SECTION

Y4 Bd sep.

PARACHUTE RIGGER 3 & 2

Y4 Bd. sep.

.S.D.

BUREAU OF NAVAL PERSONNEL

NAVY TRAINING COURSE NAVPERS 10358-A

TL 753
U52
1961

PREFACE

This Navy Training Course was prepared for personnel of both the Regular Navy and the Naval Reserve who are studying for advancement in the Parachute Rigger rating. As indicated by the title, it is based on the professional qualifications for advancement to the rates of PR3 and PR2, as stated in the *Manual of Qualification for Advancement in Rating,* NavPers 18068 (Revised). For your convenience, these qualifications are reprinted in appendix III of this training course (current through Change 16 to the "Quals" Manual). A reading list is provided in the front of the book (page vii). This reading list includes other publications recommended as study material for all Parachute Rigger personnel.

Parachute Rigger 3 and 2 was prepared by the United States Navy Training Publications Center, Memphis, Tennessee, a field activity of the Bureau of Naval Personnel. Technical assistance was provided by the staff of the Parachute Rigger Schools, NATTU, Lakehurst, New Jersey, and the Bureau of Naval Weapons, Washington, D. C.

ACTIVE DUTY ADVANCEMENT REQUIREMENTS

REQUIREMENTS *	E1 to E2	E2 to E3	E3 to E4	E4 to E5	E5 to E6	E6 to E7	† E7 to E8	‡ E8 to E9
SERVICE	4 mos. service—or completion of recruit training.	6 mos. as E-2.	6 mos. as E-3.	12 mos. as E-4.	24 mos. as E-5.	36 mos. as E-6.	48 mos. as E-7. 8 of 11 years total service must be enlisted. Must be permanent appointment.	24 mos. as E-8. 10 of 13 years total service must be enlisted.
SCHOOL	Recruit Training.		Class A for PR3, DT3, PT3.			Class B for AGCA, MUCA, MNCA.		
PRACTICAL FACTORS	Locally prepared check-offs.	Records of Practical Factors, NavPers 760, must be completed for E-3 and all PO advancements.						
PERFORMANCE TEST			Specified ratings must complete applicable performance tests before taking examinations.					
ENLISTED PERFORMANCE EVALUATION	As used by CO when approving advancement.		Counts toward performance factor credit in advancement multiple.					
EXAMINATIONS	Locally prepared tests.		Service-wide examinations required for all PO advancements.				Service-wide, selection board, and physical.	
NAVY TRAINING COURSE (INCLUDING MILITARY REQUIREMENTS)		Required for E-3 and all PO advancements unless waived because of school completion, but need not be repeated if identical course has already been completed. See NavPers 10052 (current edition).					Correspondence courses and recommended reading. See NavPers 10052 (current edition).	
AUTHORIZATION	Commanding Officer		U.S. Naval Examining Center			Bureau of Naval Personnel		
	TARS are advanced to fill vacancies and must be approved by CNARESTRA.							

* All advancements require commanding officer's recommendation.
† 2 years obligated service required.
‡ 3 years obligated service required.

INACTIVE DUTY ADVANCEMENT REQUIREMENTS

REQUIREMENTS *		E1 to E2	E2 to E3	E3 to E4	E4 to E5	E5 to E6	E6 to E7	E8	E9
	FOR THESE DRILLS PER YEAR								
TOTAL TIME IN GRADE	48	6 mos.	6 mos.	15 mos.	18 mos.	24 mos.	36 mos.	48 mos.	24 mos.
	24	9 mos.	9 mos.	15 mos.	18 mos.	24 mos.	36 mos.	48 mos.	24 mos.
	NON-DRILLING	12 mos.	24 mos.	24 mos.	36 mos.	48 mos.	48 mos.		
DRILLS ATTENDED IN GRADE †	48	18	18	45	54	72	108	144	72
	24	16	16	27	32	42	64	85	32
TOTAL TRAINING DUTY IN GRADE †	48	14 days	14 days	14 days	14 days	28 days	42 days	56 days	28 days
	24	14 days	14 days	14 days	14 days	28 days	42 days	56 days	28 days
	NON-DRILLING	None	None	14 days	14 days	28 days	28 days		
PERFORMANCE TESTS				Specified ratings must complete applicable performance tests before taking examination.					
PRACTICAL FACTORS (INCLUDING MILITARY REQUIREMENTS)		Record of Practical Factors, NavPers 760, must be completed for all advancements.							
NAVY TRAINING COURSE (INCLUDING MILITARY REQUIREMENTS)		Completion of applicable course or courses must be entered in service record.							
EXAMINATION		Standard exams are used where available, otherwise locally prepared exams are used.						Standard EXAM, Selection Board, and Physical.	
AUTHORIZATION		District commandant or CNARESTRA					Bureau of Naval Personnel		

* Recommendation by commanding officer required for all advancements.

† Active duty periods may be substituted for drills and training duty.

THE UNITED STATES NAVY

GUARDIAN OF OUR COUNTRY

The United States Navy is responsible for maintaining control of the sea and is a ready force on watch at home and overseas, capable of strong action to preserve the peace or of instant offensive action to win in war.

It is upon the maintenance of this control that our country's glorious future depends; the United States Navy exists to make it so.

WE SERVE WITH HONOR

Tradition, valor, and victory are the Navy's heritage from the past. To these may be added dedication, discipline, and vigilance as the watchwords of the present and the future.

At home or on distant stations we serve with pride, confident in the respect of our country, our shipmates, and our families.

Our responsibilities sober us; our adversities strengthen us.

Service to God and Country is our special privilege. We serve with honor.

THE FUTURE OF THE NAVY

The Navy will always employ new weapons, new techniques, and greater power to protect and defend the United States on the sea, under the sea, and in the air.

Now and in the future, control of the sea gives the United States her greatest advantage for the maintenance of peace and for victory in war.

Mobility, surprise, dispersal, and offensive power are the keynotes of the new Navy. The roots of the Navy lie in a strong belief in the future, in continued dedication to our tasks, and in reflection on our heritage from the past.

Never have our opportunities and our responsibilities been greater.

CONTENTS

Chapter Page

1. The Parachute Rigger rating 1
2. Parachute familiarization 7
3. Parachute inspection. 37
4. Parachute packing and rigging 53
5. Packing and rigging the chest type parachute. 69
6. Packing and rigging the seat type parachute 120
7. Packing and rigging the back type parachute 152
8. Packing and rigging the Martin-Baker parachute 177
9. Packing and rigging the RAPEC parachute 217
10. Automatic parachute actuators 247
11. Sewing machine operation and lubrication. 260
12. Parachute maintenance and repairs. 289
13. Fasteners. 306
14. Protective helmets and oxygen masks 321
15. Flight clothing and protective equipment. 344
16. Standard life rafts and equipment 377
17. Recharging carbon dioxide cylinders 418
18. Safety belts and shoulder harnesses. 432

CONTENTS (Continued)

Appendix Page

I. Glossary 446

II. Answers to quizzes 451

III. Qualifications for advancement in rating 455

Index 461

READING LIST

Safety and Survival Equipment for Naval Aviation, NA 00-80T-52
Parachute Manual, NA 13-5-501
Parachute Manual Supplement, NA 13-5-501A
Military Requirements for Petty Officer 3 and 2, NavPers 10056

CHAPTER 1

THE PARACHUTE RIGGER RATING

Many men engaged in a great number of specialized fields are needed to maintain the Navy's air arm in a condition of constant military readiness. All these specialists are mutually dependent, and each contributes his part to the efficient operation of the entire organization.

The Parachute Rigger is an important member of this team of specialists which keeps naval aviation the most potent force of its kind in the world. In fact, you could not have chosen a more self-satisfying field of work than that performed by the Parachute Rigger.

The Parachute Rigger has as his primary mission the business of saving lives, a mission equally important in peace as well as in war. One generally thinks of the aviator as trusting his life to the aircraft he is flying, but if for some reason the aircraft becomes disabled, the aviator probably would be doomed—except for the equipment that the Parachute Rigger has so expertly provided for such an emergency. With this equipment, aviators and their crews are able to abandon their disabled aircraft, parachute to safety and survive on land, at sea, or even in the arctic wastelands—all because the Parachute Rigger did his work well. He not only did his job well; he did it perfectly.

Everything the Parachute Rigger does must be done flawlessly. Perfection becomes the standard by which he lives. The man who approaches his daily work with a tongue-in-cheek attitude should look elsewhere for his advancement. Such an approach leads only to trouble—quick, certain, and in large quantities—when a man is working with lifesaving equipment.

The Parachute Rigger knows this, and the precept he always has before him is one that has never been improved upon where man works with his fellowman—the Golden Rule—"Do unto others as you would have them do unto you."

The Parachute Rigger (PR) rating was established in 1942, shortly after the beginning of World War II. Prior to that time, parachute rigging was performed by personnel of the Aviation Machinist's Mate and Aviation Metalsmith ratings along with their other duties. With the beginning of the war, the work of the Parachute Rigger had increased to such an extent that the Bureau of Naval Personnel established the Parachute Rigger rating.

Before describing the duties and responsibilities of the present-day Parachute Rigger, let us take a look at the latest revision to the enlisted rating structure and see just how the Parachute Rigger fits into the overall program.

ENLISTED RATING STRUCTURE

The enlisted rating structure is the primary tool for the classification of Navy enlisted personnel. It is a systematic alignment of occupational groups (rates and ratings).

Enlisted ratings are divided into a total of twelve groups, all ratings within a particular group being occupationally related. For example, all ratings relating to aviation are in group IX, the aviation group.

Jobs requiring basically the same aptitudes, knowledges, and skills are grouped under one rating. Within each rating are steps for advancement, and with each step there is an increase in pay. These steps, or pay grades, are rates within a rating. For example, PR3 is a rate within the PR rating.

Types of Ratings

Under the latest revision to the rating structure for enlisted personnel of both the regular Navy and the Naval Reserve there are three types of ratings—GENERAL, SERVICE, AND EMERGENCY.

A general rating reflects qualification in all aspects of an occupational field and insures broadly qualified senior petty officers. A service rating reflects qualifications in some of the aspects of an occupational field and provides specialization where it is deemed desirable. An emergency rating reflects qualification in a civilian skill which is not identified in the peacetime Navy but is required to be identified in wartime.

Parachute Rigger Rating Structure

Under this realignment, the Parachute Rigger rating is composed of a general rating, PR. In other words, there are no service ratings; the general rating, PR, applying to all pay grades (E4 through E9) for personnel of both the regular Navy and the Naval Reserve. This alignment insures broadly trained petty officers in all pay grades of the rating.

In case of war or other national emergency, specialization could be provided by establishing emergency ratings.

SCOPE OF THE PR RATING

According to the *Manual of Qualifications for Advancement in Rating,* NavPers 18068 (Revised), Parachute Riggers have the following duties and responsibilities:

Inspect, maintain, and repair parachutes, survival equipment, and flight and protective clothing and equipment.

Pack and rig parachutes.

Pack and equip life rafts.

Repair and test oxygen regulators and liquid oxygen converters removed from aircraft.

Fit and maintain oxygen masks, flight clothing, antiexposure suits and anti-g suits.

Test and service full pressure suits.

Operate and maintain carbon dioxide and oxygen shop transfer and recharge equipment.

Operate sewing machines.

Maintain and repair sewing machines.

Test safety belts and shoulder harnesses removed from aircraft.

Supervise operation of parachute lofts, oxygen shops, and survival shops.

Instruct personnel in the proper techniques of survival.

QUALIFICATIONS FOR ADVANCEMENT

The minimum requirements for advancement in rating are set forth in the *Manual of Qualifications for Advancement in Rating,* NavPers 18068 (Revised), commonly referred to throughout the Navy as the "Quals Manual."

In addition to serving as a guide for enlisted men in preparing for advancement, the Quals Manual is also used as a guide in the preparation of Navy Training Courses, school curricula, and all servicewide advancement-in-rating exams.

The Quals Manual is kept up to date to meet the needs of the Navy by Changes to the Manual, issued periodically by the Bureau of Naval Personnel. The Manual is composed of two main sections, titled Military Requirements and Professional Qualifications.

Military requirements are the general qualifications which all enlisted personnel are expected to demonstrate as a minimum for advancement to specific pay grades.

Professional qualifications are the requirements for advancement in a specific rating. The professional qualifications for the entire PR occupational field are reprinted in appendix III of this book. These quals are current as of the date of Change 16 to the Quals Manual.

Requirements for advancement are itemized under the following subject-matter areas: Safety, Parachutes, Fabric Work, Flight and Protective Clothing and Equipment, Survival Equipment, Oxygen Equipment, and Administration.

Each of these areas is further broken down into Practical Factors and Knowledge Factors. The pay grade to which each Practical Factor and Knowledge Factor applies is listed under the "Applicable Rates Column."

The Practical Factors are qualifications which state particular tasks that are carried out on the job and can best be tested by means of practical demonstration.

The Knowledge Factors are qualifications which include the minimum knowledges required for work performance. How well you know these qualifications is best shown by means of a written examination.

It should be kept in mind that before being recommended to take the advancement-in-rate examination you must complete all the Practical Factors applicable to the rate for which you are striking. As you show proficiency in each practical factor, a record of its completion will be made on a standard form titled, *Record of Practical Factors,* NavPers 760.

Record of Practical Factors

The *Record of Practical Factors,* NavPers 760 (PR) provides a standard checkoff list of both military and professional practical factor qualifications required to be demonstrated in each pay grade as a prerequisite for advancement. Space has been provided on the form for your supervising officer to initial and enter the date of completion of each factor.

Each command maintains a Record of Practical Factors for each enlisted man in pay grades E-3 through E-8 (airman through senior chief). When you are transferred, your Record of Practical Factors will be signed, inserted in the correspondence side of your enlisted service record, and forwarded to your new duty station. In this way, your record will be kept up to date and used on a continuing basis as you progress in your rating.

You will be provided a personal copy of your record so that you can keep up to date on your progress. Your personal record will also serve as a reminder of things you must be able to demonstrate prior to advancement.

Parachute Rigger School

The Parachute Rigger (Class A) School, located at Lakehurst, New Jersey, is designed to provide PR strikers with the understanding and knowledge which lead to the fulfillment of the technical requirements for advancement to Parachute Rigger, Third Class. The opportunity is provided to make one premeditated free-fall descent, using a parachute packed by the student, under the supervision of a qualified instructor. This is on a strictly voluntary basis after the man arrives at the school.

Entrance requirements to the PR(A) School are as follows:

Candidate must have a minimum GCT plus MECH score totaling 105. Twenty-four months of obligated service from the date of entry is required.

STUDYING FOR ADVANCEMENT

The Bureau of Naval Personnel issues many training publications for use by enlisted personnel in studying for advancement. These publications are listed for each individual rating in a booklet titled *Training Publications for Advancement in Rating,* NavPers 10052.

This booklet is revised and reissued annually and is the official bibliography of reference sources from which servicewide examination questions are taken. The latest edition is always available for reference in your education office and should be referred to prior to studying for advancement. Training courses which are marked with an asterisk (*) must be completed by passing the Enlisted Correspondence Course based on that training course, or by passing a locally prepared and administered test.

Another valuable reference source is the publication titled *List of Training Manuals and Correspondence Courses,* NavPers 10061. NavPers 10061 is an alphabetical listing (catalog) of all types of training publications, both officer and enlisted. This catalog is revised and reissued semiannually and includes the following alphabetical listings: Training Manuals, Navy Training Courses, Enlisted Correspondence Courses, and Officer Correspondence Courses. Preceding the listing of Enlisted Correspondence Courses is a section on the Enlisted Correspondence Program which outlines the function of the program and gives detailed instructions for making application for enrollment.

NavPers 10061 is distributed to all ships and stations, and the latest edition is always available in your education office.

Navy Training Courses

Navy Training Courses are of three general types, each designed to aid the enlisted man in preparing for advancement. They are classed as: General Courses, Basic Courses, and Rating Courses.

GENERAL COURSES

General courses cover the military requirements required of all petty officers. Included as mandatory reading in this group are *Military Requirements for Petty Officer 3 and 2* for advancement to pay grades E-4 and E-5, and *Military Requirements for Petty Officer 1 & C* for advancement to E-6 and E-7. Certain chapters of several other general courses are listed as recommended reading and may be used as sources for examination questions. For this listing refer to the current edition of NavPers 10052.

BASIC COURSES

Basic courses cover such fundamental subjects as blueprint reading, mathematics, use of handtools, basic electricity, hydraulics, and the like. As can be seen, subjects which are useful to more than one rating are covered in basic courses. Certain sections of the following basic courses are of interest to the Parachute Rigger:

Blueprint Reading and Sketching, NavPers 10077-A.

Basic Hand Tool Skills, NavPers 10085.

Basic Machines, NavPers 10624.

RATING COURSES

Rating courses cover the professional qualifications for a specific rate or rates. The Quals Manual is used as a guide in preparing rating courses. This means that each qualification in the Quals Manual is covered either by adequate material in the rating book itself, by reference to a basic course, or by reference to some other satisfactory and readily available publication.

Rating courses are revised from time to time to keep pace with new developments in equipment, as well as to comply with changes to the Quals Manual. In studying for advancement, always check the current edition of NavPers 10052 for the date of the latest issue of your rating course or courses.

Enlisted Correspondence Courses

An Enlisted Correspondence Course consists of an assignment booklet, a set of answer sheets, and textbook; the textbook being the training course upon which the correspondence course is based. Correspondence courses are prepared for the purpose of helping you get the most out of your Navy Training Courses. The assignments focus attention upon various types of information, including important definitions, reasons why certain operations are performed in a special manner, the cause and effect of various actions, the similarity or difference between related objects, the recognition and identification of errors, the orderly arrangement of steps in an operation, and common principles which apply to two or more situations.

In working out correspondence course assignments, you should discuss difficult points with shipmates; however, the answers selected should be your own.

As mentioned earlier in the chapter, the current edition of *Training Courses and Publications for Advancement in Rating,* NavPers 10052, lists the Navy Training Courses which are mandatory. (Look for the asterisk (*) following the training course title.) One column of the listing indicates the Enlisted Correspondence Courses (ECC) meeting these Navy Training Course requirements. Other publications recommended for study are listed and some of these have associated Enlisted Correspondence Courses.

An alphabetical listing of Enlisted Correspondence Courses also may be found in the current issue of *List of Training Manuals and Correspondence Courses,* NavPers 10061, described earlier in the chapter.

This Training Course

This training course is based on the professional qualifications for the rates of PR3 and PR2, as set forth in the Quals Manual (through Change 16). It is designed primarily for use by the striker who is studying for advancement to PR3 and the PR3 who is studying for advancement to PR2.

Satisfactory completion of this training course is mandatory before you can become eligible to participate in the advancement in rating examination. Keep in mind, completion of this course may be accomplished by passing the Enlisted Correspondence Course or by passing locally prepared and administered tests. There is usually a short period of time after a training course is distributed before the associated correspondence course is available.

Suggestions for Studying

Here are some ways that have been found to be effective by men studying Navy Training Courses for advancement.

Start by reading the preface, table of contents, and index. Then thumb through the entire book, looking at the illustrations and reading bits here and there as your eyes fall on something interesting. This browsing will show you how the book is organized and the subject matter it covers.

Next, preread the entire course. Do this to learn the relationship of parts and chapters to the whole of the rating covered in the course. Read the introductions to each chapter. Then read the headings and subheadings. Ask yourself such questions as: What do I already know about this particular topic? How are these topics interrelated? What am I expected to know about this process or technique?

Learn the qualifications for advancement in your rating (in the appendix). You are studying the NTC in order to meet these "Quals."

Check the chapter study guide in the front of the book for the chapters most pertinent to the rate you seek.

These preliminary steps orient you and help you plan your study. They put you in a better position to draw on personal experience and to relate your past experience to the new material.

After this preliminary work you are ready to fill in the details by intensive study of the chapters, sections and subsections. What you can cover during a study session depends on (1) the difficulty of the material; (2) what you already know about the topic; and (3) your skill as a reader. At any rate, for each study session plan to master a predetermined unit of material: an entire chapter or a major section of a chapter.

Use the PREREADING system with each section and paragraph. Skim the introduction, headings, first and last sentences of each paragraph, and all summarizing statements. As you preread; think up questions about the material. Write down these questions for future reference. Another useful technique is to make an outline during pre-reading, filling in the details later. When you have finished prereading, think about what you have learned thus far. Ask yourself such questions as: What main ideas are presented? What details must I look for?

Next, read the entire chapter or section completely and carefully. As you read be on the lookout for the questions you have thought about or the details of your outline. Relate the part to the whole. Relate your previous knowledge and background experience to the discussion. Identify yourself with the situations, processes, and techniques; visualize yourself doing the things that are described.

Recite what you have learned. This is the proof of understanding. Look at the questions you wrote down during prereading. Do you know the answers? Can you answer the questions in the quiz at the end of the chapter? Try to master the material you are studying before proceeding to a new portion of the text.

ASSIGNMENTS AVAILABLE TO PR3 AND PR2

As a PR3 or PR2, you may be attached to any one of the three types of aircraft maintenance activities—a squadron, an air station, or the air department of an aircraft carrier. Regardless of which types of activity you are attached to, you will more than likely be assigned to the parachute loft, the survival shop, or the oxygen shop. Where a shortage of qualified AME's exists, it is possible that you might be assigned to the airframes division. At the present time the AME rating is in the process of taking over many of the duties formerly performed by the Parachute Rigger rating. Until a sufficient number of qualified AME's are available, Parachute Riggers can expect to be called upon to train AME's and assist in performing the work of the AME rating. In such instances, you may be assigned to the airframes division on a temporary basis.

The Squadron

The squadron is the standard operating unit in naval aviation. Each squadron has a number of assigned aircraft; the number and type depending upon the mission of the squadron (fighter, attack, patrol, etc.). Each squadron is also assigned a number of personnel for operation, maintenance, and repair of its aircraft and equipment and maintenance and repair of the pilot's and aircrewmen's flight clothing and survival equipment. The number of personnel will depend upon the type of squadron (supported or self-supporting).

All squadrons (regardless of type) are made up of a number of departments, the largest of which is the aircraft maintenance department. It is to this department that you are likely to be assigned.

As a member of the maintenance department of a squadron, you are likely to be assigned to the aviation equipment branch. Other branches are power plants, avionics, ordnance, and airframes.

Within the aviation equipment branch are the parachute loft and the oxygen shop, both of which are under the supervision of a senior Parachute Rigger. As a Parachute Rigger striker, your work will depend upon the type of squadron and the number of Parachute Riggers assigned to the squadron. In one outfit, you may be assigned to the parachute loft; while in another, your work may be confined to the oxygen shop. In still another, you may be working in both the parachute loft and oxygen shop. In any case, you will be working with a qualified Parachute Rigger who will instruct and train you in the proper use of shop equipment and in performing the duties of your rate.

The Naval Air Station

Parachute Riggers and Parachute Rigger strikers attached to a naval air station are assigned to the aviation equipment branch of the shops division. Although the organizational setup is similar to that of the squadron, everything is on a much larger scale.

More aircraft must be maintained and any number of different types and models are likely to be involved. While the average squadron will have only one or two different types of aircraft to maintain, an air station will generally have several different types. Naval air station personnel not only service and maintain their own assigned aircraft but also transient aircraft. They also assist any supported squadrons which may be stationed there. This makes the work of the Parachute Rigger much more varied and on a much greater scale.

The aviation equipment branch is generally broken down into four sections—oxygen, parachutes, pressure suits, and flotation equipment (life rafts and vests). As a striker, you may be assigned to any one of these shops where you will be instructed and trained in performing the duties of your rate.

The Aircraft Carrier

Parachute Riggers attached to an aircraft carrier are assigned to the aircraft maintenance division of the air department. Ship's company personnel provide the same service to embarked squadrons as naval air station personnel do ashore. Of course, shop spaces are on a much smaller scale, and all work must be done on a much tighter schedule.

QUIZ

1. Under the latest revision in the enlisted rating structure, what are the three types of ratings?
    a. General, aviation, special
    b. Emergency, service, general
    c. Aviation, emergency, general
    d. Emergency, general, reserve
2. All ratings relating to aviation are in group
    a. IX
    b. X
    c. V
    d. IV
3. Parachute Riggers have certain duties and responsibilities to perform which may be found in
    a. Flight Handbooks
    b. Manual of Qualifications for Advancement in Rating
    c. Opnav Instructions
    d. BuWeps Aviation Clothing and Survival Equipment Bulletins
4. Navy Training Courses are classified under what three types?
    a. Home Study, Group Study, USAFI
    b. General Courses, On-the-Job Training, Class
    c. Correspondence Courses, Rating Courses, Home Study
    d. General Courses, Basic Courses, Rating Courses
5. Navy Training Courses which are mandatory are listed in
    a. Manual of Qualifications for Advancement in Rating
    b. Military Requirements for Petty Officer 3 & 2
    c. Training Courses and Publications for Advancement in Rating
    d. List of Training Manuals and Correspondence Courses
6. Parachute Riggers, as a rule are assigned to the following department.
    a. Operations
    b. Maintenance
    c. Administration
    d. Airframes
7. The aviation equipment branch is generally broken down into four sections--oxygen, parachutes, flotation, and
    a. survival
    b. g-suits
    c. pressure suits
    d. expansion suits
8. Rating courses cover what qualifications for a specific rate or rates?
    a. Professional
    b. Military
    c. Aviation
    d. All of the above
9. Which of the following is covered by the basic Navy Training Courses?
    a. Military Requirements for Petty Officers
    b. Enlisted Correspondence Course
    c. Blueprint Reading and Sketching
    d. Navy Training Courses
10. As proficiency is shown in each practical factor, a record of its completion will be made on Record of Practical Factors, Form
    a. 760
    b. 10052
    c. 10061
    d. DD1150

CHAPTER 2

PARACHUTE FAMILIARIZATION

You have probably heard that a parachute operates something like this—"The jumper pulls a cord and out pops a nylon umbrella which inflates and lets him float safely to earth." Actually there is little more to the operation. It is the purpose of the first part of the chapter to give you a better understanding of just what does occur during the operation of a parachute. Thence, you will have a better picture of the relationship of parts. Jumping techniques and procedures will be explained later. We are now interested in the mechanics of the parachute.

BRIEF HISTORY

As far back as 1495, Leonardo da Vinci designed a parachute consisting of a pyramid of cloth. Many of da Vinci's ideas have been incorporated in modern parachutes.

In 1617, Fouste Veranzio jumped from a tower in Venice, using as a parachute a square, wooden framework covered with canvas.

This brief bit of background discloses that the idea of the parachute is by no means new. It also indicates that the numerous devices of yesteryear were intended primarily as forms of amusement. The possibilities of the parachute as a lifesaving device never occurred to any of the early designers as there was no need for an aerial lifesaving device.

Interest in parachutes was renewed in 1783, when the Montgolfier Brothers succeeded in making a balloon. In order to maintain the necessary supply of hot air to keep the balloon aloft, aerial navigators often burned bundles of straw beneath the bag. If the fabric caught fire, the flight was abruptly ended. The fact that men went aloft and that such flights made quick escape and descent imperative, removed the parachute from the stunt classification. In 1808, a Polish balloonist named Kuparento became the first aerialist to leap to safety with a parachute from his blazing bag of hot air.

For nearly a century following Kuparento's jump, the need for foolproof parachutes was not sufficiently acute to stimulate a great deal of inventive effort. When the Wright Brothers, in 1903, stayed aloft in their primitive plane at Kitty Hawk, the air age came into being, and the parachute left the sideshow to become, once and for all, an integral part of aviation.

Now came a period of experimentation with parachutes especially designed for use with the new type of aircraft. The old balloon type of parachute had proven entirely unsatisfactory as it constantly fouled when used in the faster moving airplane.

The first successful jumps from aircraft were performed with makeshift parachutes. Grant Morton jumped from a plane carrying a loosely folded parachute in his arms. After clearing the plane, he tossed the bundle of silk to the breeze where it caught and billowed. In 1912, Capt. Albert Berry made a jump using a parachute packed in a cone-shaped metal cylinder attached to the underside of the fuselage, just over the axle. Berry crawled from the cockpit to the axle and slid onto a trapeze bar which served as a "harness." When he jumped, the weight of his body pulled the parachute from the container.

During World War I, balloonists became observers and artillery fire directors, and because such duty was highly hazardous, these aviators wore parachutes. The record shows that the lives of 800 balloonists were saved by parachutes during the First World War.

Parachutes were not considered essential equipment for World War I aviators, and less than one one-hundredth of one percent of aerial missions made during the struggle were flown by pilots wearing parachutes. The resultant mortality rate among pilots on active duty at the front was very high. As a result, the need for an efficient, man-carrying parachute that could be used in an emergency became a primary requirement between 1916 and 1918.

Thus, out of World War I came various types of parachutes—the Heinecke (German), the Mears and Guardian Angel (British), the Orrs and S.T.A. (French), and the A.E.F. (American). All of these parachutes were heavy and unwieldy, and none were safe at speeds exceeding 100 miles per hour.

It was an accepted fact that parachutes could save lives if they worked. The next logical step was that of rendering them foolproof.

PRINCIPLES OF OPERATION

Figures 2-1 through 2-7 illustrate the order of events in the operation of a parachute. These illustrations should be studied until the chain of events is thoroughly understood.

DESIGN AND CONSTRUCTION

A parachute is not made up of gears, shafts, and bearings, as are many things with which you may be more familiar. A complete service parachute consists of (1) the pilot chute, (2) the canopy, (3) the suspension lines, (4) the pack, and (5) the harness. The pilot chute is a small parachute attached to the top of the main canopy. Its purpose is to pull the canopy from the pack quickly. The canopy is the large umbrella-like area of nylon cloth which slows the descent of the jumper. The suspension lines are the lines which connect the canopy to the harness. The pack is the nylon assembly which encloses the pilot chute, canopy, and suspension lines. The harness is an arrangement of nylon webbing and metal fittings. It is worn by the jumper and can provide a seat or sling during descent. It also serves to carry the pack when the parachute is being worn.

The device which trips or releases the parachute is called a ripcord. It consists of a grip or handle, a length of cable, and two or more short pins. It is fastened to the harness and pack by means of a pocket, a housing, and locking cones. The importance of its working properly cannot be overemphasized.

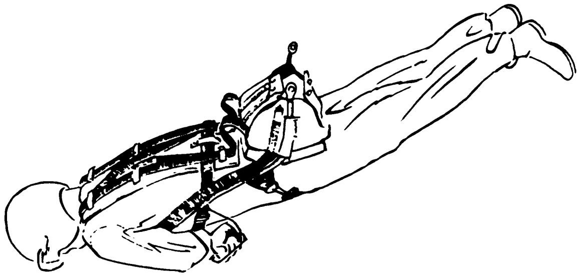


Figure 2-1.—Exerting a pull in excess of 22 pounds on the ripcord releases the ripcord pins from the locking cones. The sides and ends of the pack are then drawn back by spring opening bands.

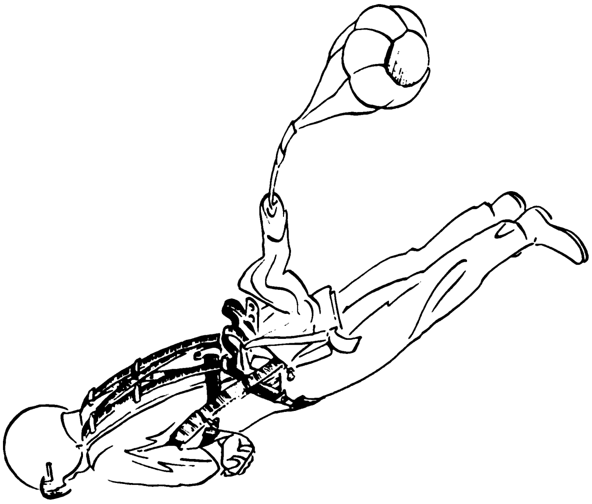


Figure 2-2.—The pilot chute springs beyond the negative pressure area immediately above the falling body. This results in its getting a better "bite" on the surrounding air and thus speeds the opening of the main canopy.

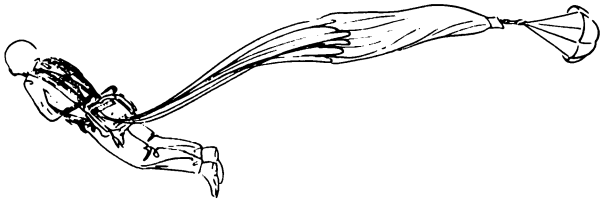


Figure 2-3.--Canopy completely extended. Suspension lines almost out of pack.

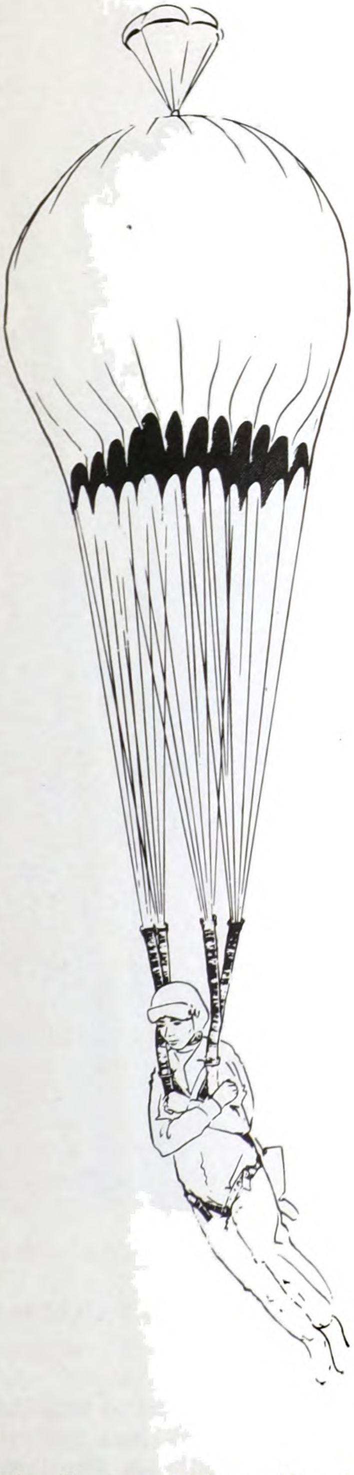


Figure 2-4.—Canopy filling with air. Body assuming an upright position.

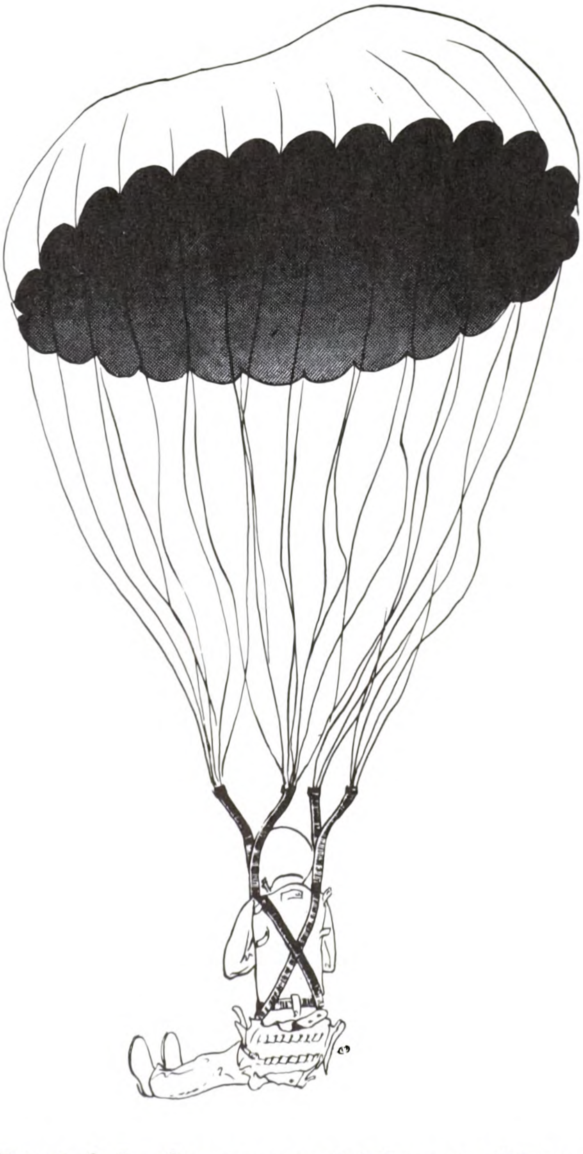


Figure 2-5.—Canopy completely open. Riser or lift web tackings broken. Lift webs pulled from pack. Opening shock felt.

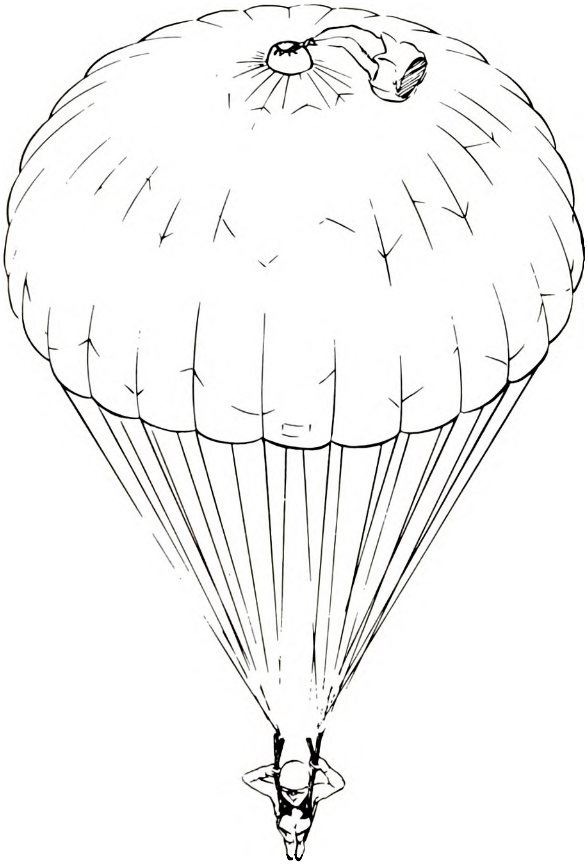


Figure 2-6.—Parachute fully open. Canopy has assumed normal inflated shape and size. Steady rate of descent established. Pilot chute, no longer needed, resting on canopy.

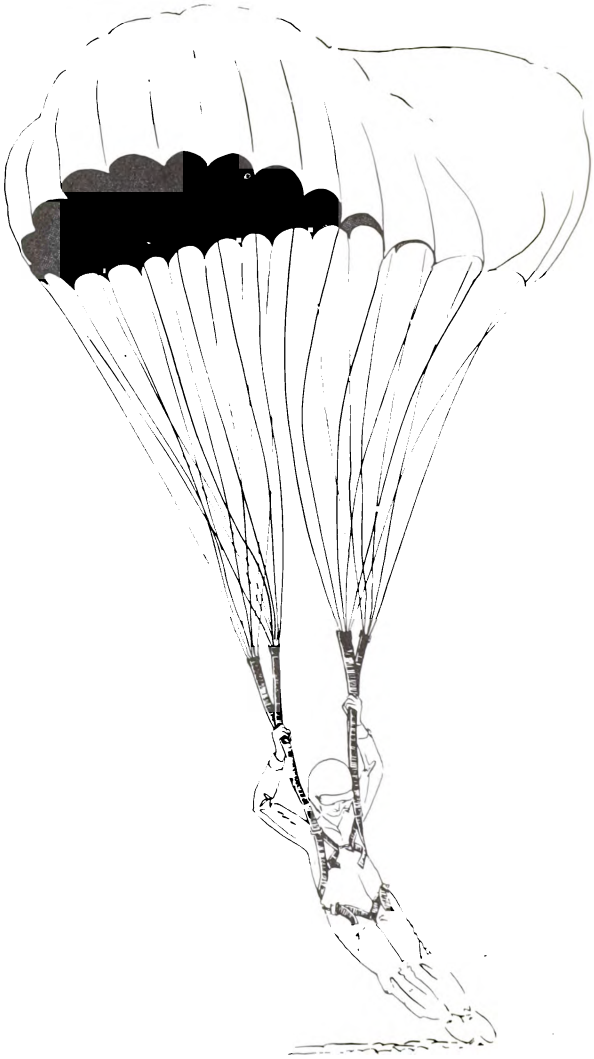


Figure 2-7.—Parachute deflating as body touches ground.

Types Of Parachutes

There are three basic types of parachutes now in service use by the Navy. These are the chest, seat, and back types. A fourth, the training or troop type jump outfit, is used in limited numbers for experimental and training purposes. The term SERVICE is used to refer to those parachutes (seat, back, and chest types) used primarily for emergency jumps and does not include the training types.

NAVY CHEST TYPE PARACHUTE

Figure 2-8 illustrates the attachable chest type parachute. This parachute is designated as type NC-3R or type NC-3O. The letter "N" is the designation for Navy, the "C" for chest, and the "3" means that it is the third change or modification of the basic design. The letters "R"

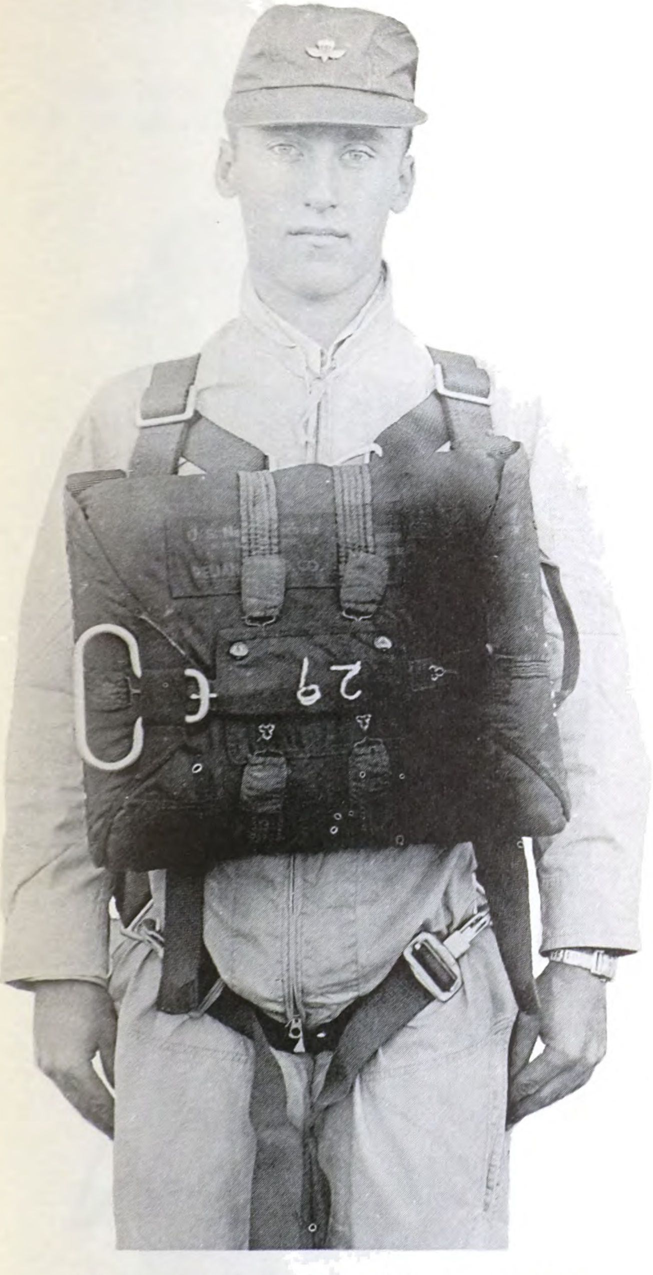


Figure 2-8.—Navy chest type parachute.

or "O" mean that the harness is either "regular" size or "oversize." The pack of this parachute is attached to the harness with quick connector hardware and is worn on the chest. This parachute was designed for the use of pilots and crewmen whose duties require freedom of movement away from their regular flight stations. When the chest type parachute is used, the regulations require that the harness be worn at all times during flight. The pack is usually stored in an accessible spot either near the individual's flight station or bailout station permitting the crewman to maintain operating efficiency and still provide a high degree of safety. This accessibility of the pack allows quick attachment to the harness before bailing out. To be completely effective, it is absolutely necessary that every person using a chest type parachute be properly trained in its use. It is obvious that each person aboard an aircraft should be continuously aware of the exact location of his pack at all times. The chest type parachute is designed for use in VA, VP, and VR type aircraft. Future development will probably bring about an acceptable attached parachute which will provide the same freedom of movement as the present harness and provide the additional safety of the attached pack.

NAVY SEAT TYPE PARACHUTE

Figure 2-9 illustrates the standard Navy seat type parachute. Seat type parachutes are designated as type NS-3. The regular size harness (NS-3) is shown in figure 2-9.

The seat type parachute is one of the oldest types, but is still widely used by the Navy. The seat type was formerly designated SS (standard seat). The first of the SS parachutes was used in 1924 and had a 24-foot canopy. The SS model continued in use well into the 1940's.

The critical material shortages of World War II brought about design changes and material substitutions in parachutes as well as in other things. The need for conservation of materials hastened the development of the Quick Attachable Seat Type Parachute (designated the QAS). Along with the development of the QAS parachute came the quick fit harness. The pack was made so that it could be quickly attached to the harness. The separate harnesses were made so that they could be readily adjusted to the wearer.

Later a further improvement resulted in the development of a harness that could be adjusted to the individual wearer in almost a matter of seconds. Parachutes equipped with this harness were known as the Quick Fit Seat (QFS). The pack and harness were not detachable.

In 1948 the QFS was redesignated the NS-2R. Design and development of this parachute was carried out at the Naval Air Material Center.

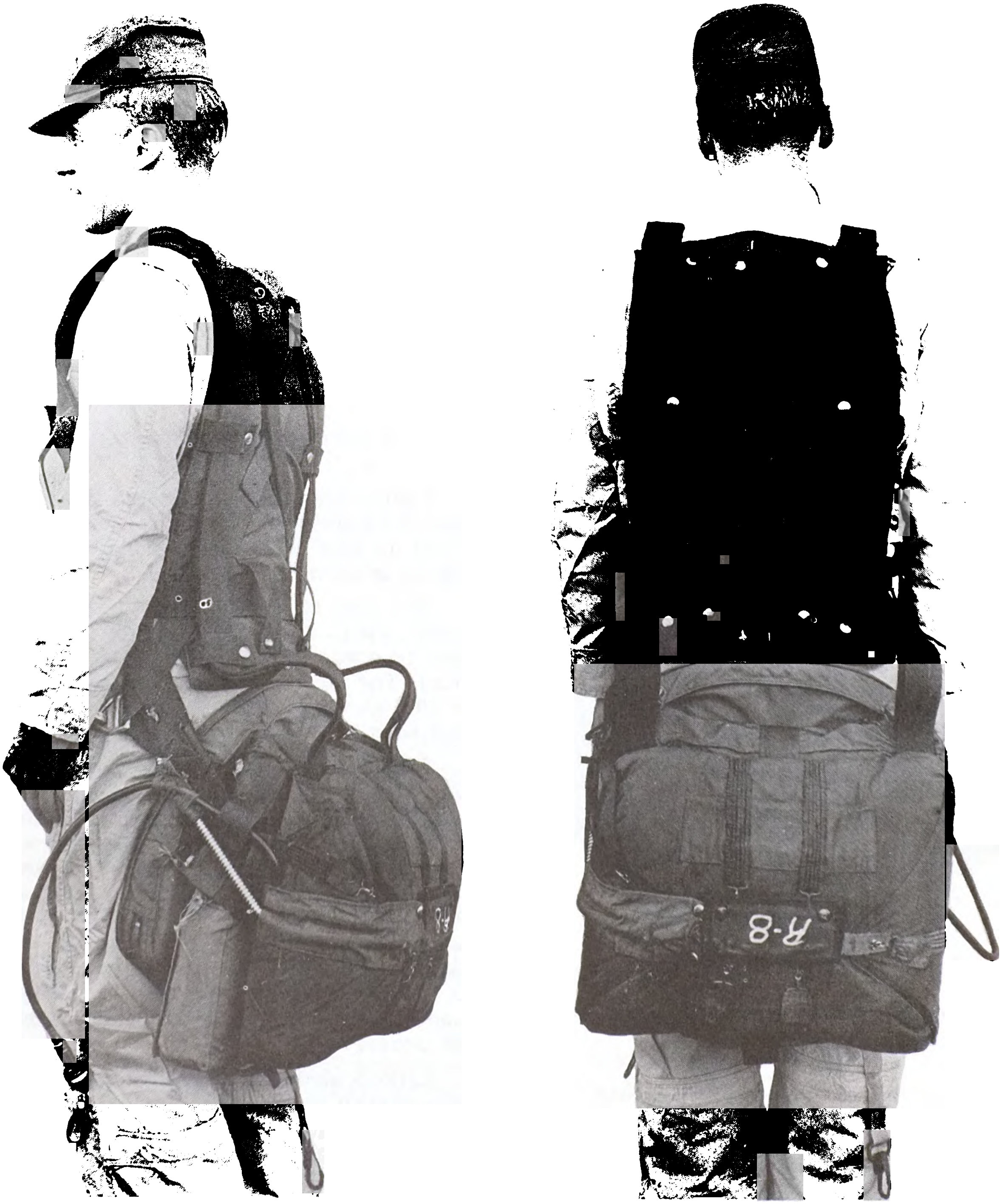


Figure 2-9.—Navy seat type parachute.

NAVY BACK TYPE PARACHUTE

The Navy back type parachute (designated NB) is worn on the back, as shown in figure 2-10. Although early models of the back type parachute saw very little service use, later designs are ideally suited for use with jet powered aircraft, the ejection seat, and its automatic devices.

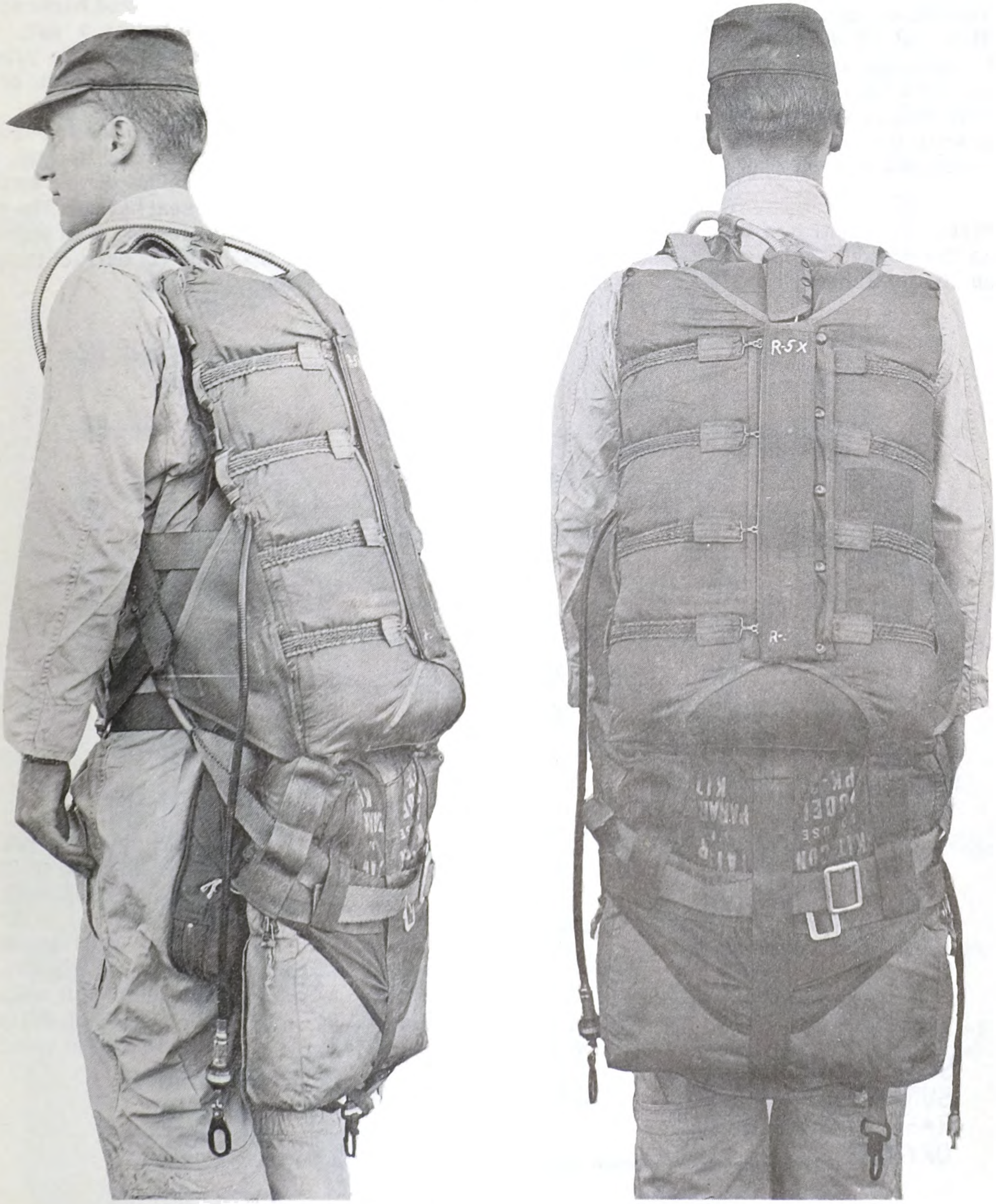


Figure 2-10.—NB-8 parachute with PK-2 pararaft.

Parachutes of the general type are the NB-5, NB-6, NB-7 and NB-8. The NB-5 and NB-7 are designed to be worn with the integrated harness. These types are a part of the ejection seat escape system. The harness combines the lap belt and shoulder harness into the assembly. The NB-5 and NB-6 contain a 26-foot conical canopy. The NB-7 and NB-8 contain a 28-foot flat canopy. By installing an automatic parachute actuator, all of the back type parachutes can be used in the ejection seat. The actuator will pull the ripcord when the pilot reaches a safe altitude or has decelerated to a safe speed.

Figure 2-11 illustrates the NB-7 adapted for use with the Rocket Assisted Personnel Ejection Catapult (RAPEC) escape system.

MARTIN-BAKER PARACHUTE

The personnel parachute used with the Martin-Baker ejection seat has a 24-foot canopy enclosed in a horseshoe-shaped back pack, especially designed for use with this seat. Figure 2-12 shows the parachute pack and harness assembly which form an integrated unit. The horseshoe-shaped pack is designed to provide the proper ejection posture by means of the shoulder harness and takeup mechanism.

Two drogue parachutes, a 22-inch controller drogue and a 5-foot stabilizer drogue, are packed in a wedge-shaped container and secured to the top front face of the seat beams. The purpose of the drogue parachutes is (1) to stabilize and decelerate the seat, and (2) extract the personnel parachute from its pack.

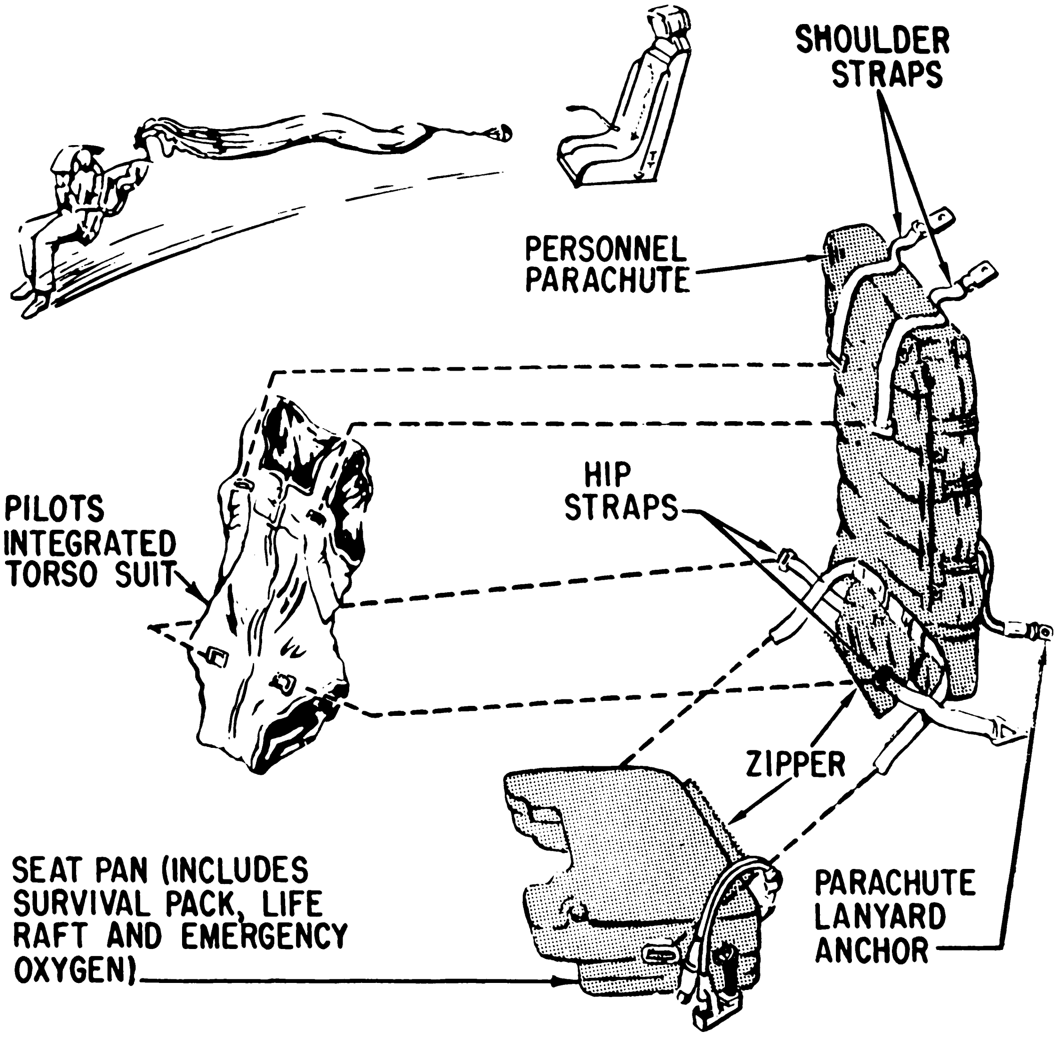
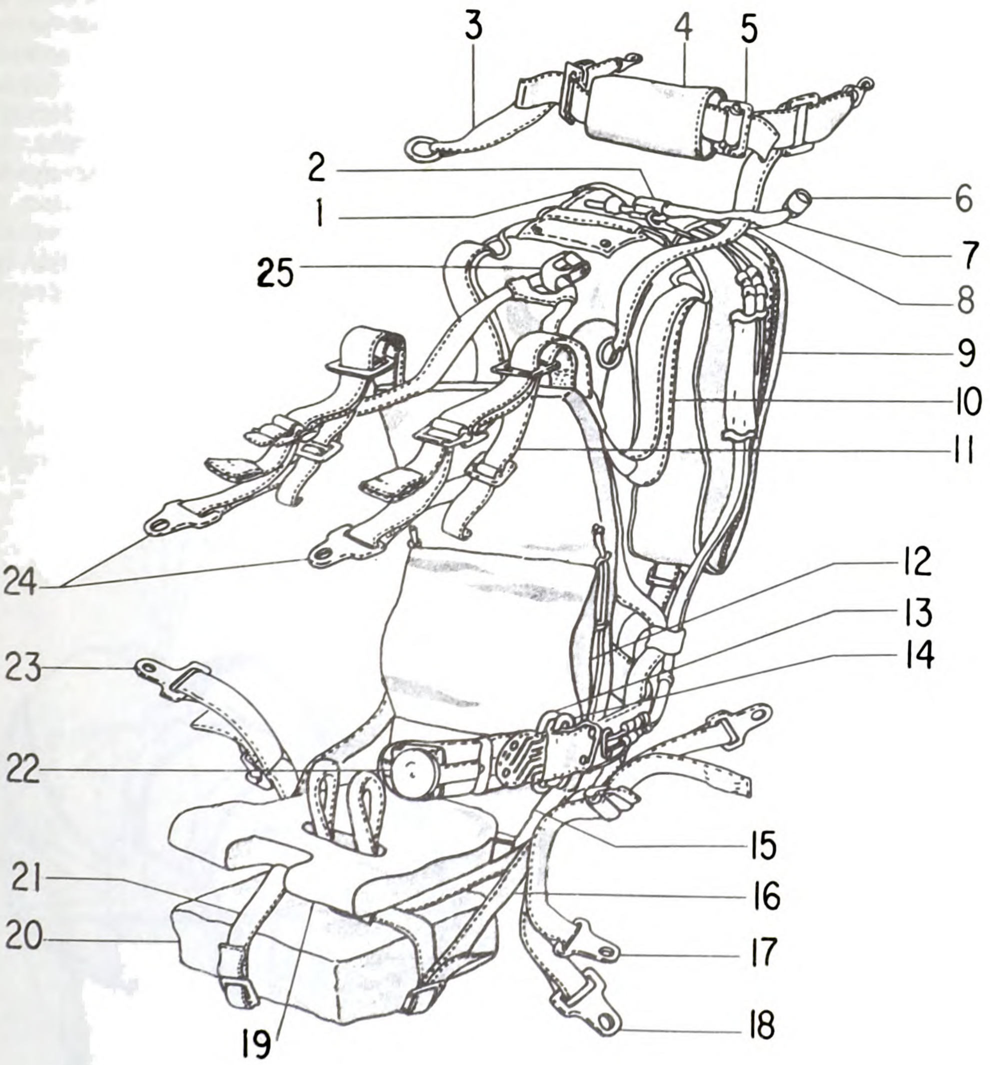

SHOULDER STRAPS
PERSONNEL PARACHUTE
PILOTS INTEGRATED TORSO SUIT
HIP STRAPS
ZIPPER
SEAT PAN (INCLUDES SURVIVAL PACK, LIFE RAFT AND EMERGENCY OXYGEN)
PARACHUTE LANYARD ANCHOR

Figure 2-11.—NB-7 parachute with accessories.



1. Parachute withdrawal line.
2. Slide disconnect.
3. Parachute restraint strap (2).
4. Wedge pack.
5. Adjustment.
6. Link line quick disconnect.
7. Slide disconnect line.
8. Loop in link line.
9. Personnel parachute pack.
10. Personnel parachute riser (2).
11. Adjustable harness.
12. Adjustable back pad.
13. Slide disconnect D-ring.
14. Parachute ripcord D-ring.
15. Pararaft attachment flap.
16. Pararaft attachment strap (2).
17. Sticker strap lug (2).
18. Harness restraint strap lug (2).
19. Seat pan.
20. PK-2 pararaft.
21. Seat cushion attachment strap.
22. Quick release box.
23. Thigh strap harness lug (2).
24. Shoulder strap harness lugs (2).
25. Roller yoke.

Figure 2-12.—Martin-Baker parachute and harness assembly.

TROOP TYPE PARACHUTE ASSEMBLY

Figure 2-13 illustrates the troop outfit. For all practical purposes, it may be considered as a standard back pack parachute with a chest pack attached to the same harness. Bureau of Naval Weapons regulations, like those of the Federal Aviation Agency, require that two packs be worn when making training or demonstration parachute jumps. The troop assemblies are designated type NT-5R or type NT-5O, depending on whether the flat circular canopy is a 28-foot (regular) or a 32-foot (oversize) one.

The troop outfit is rarely used in the Navy except at the Parachute Rigger School at Lakehurst, New Jersey, and the Naval Parachute Facility at El Centro, California. In order for naval personnel to make a premeditated jump at other than these two activities, it is necessary to pass a rigid physical examination and to have obtained, through the chain of command, the permission of the Chief of Naval Operations.

Components of Parachutes

''A chain is no stronger than its weakest link.'' The design and the construction of a parachute is based on that idea. Every link from the jumper to the canopy must carry its share of the maximum load applied during the opening shock.

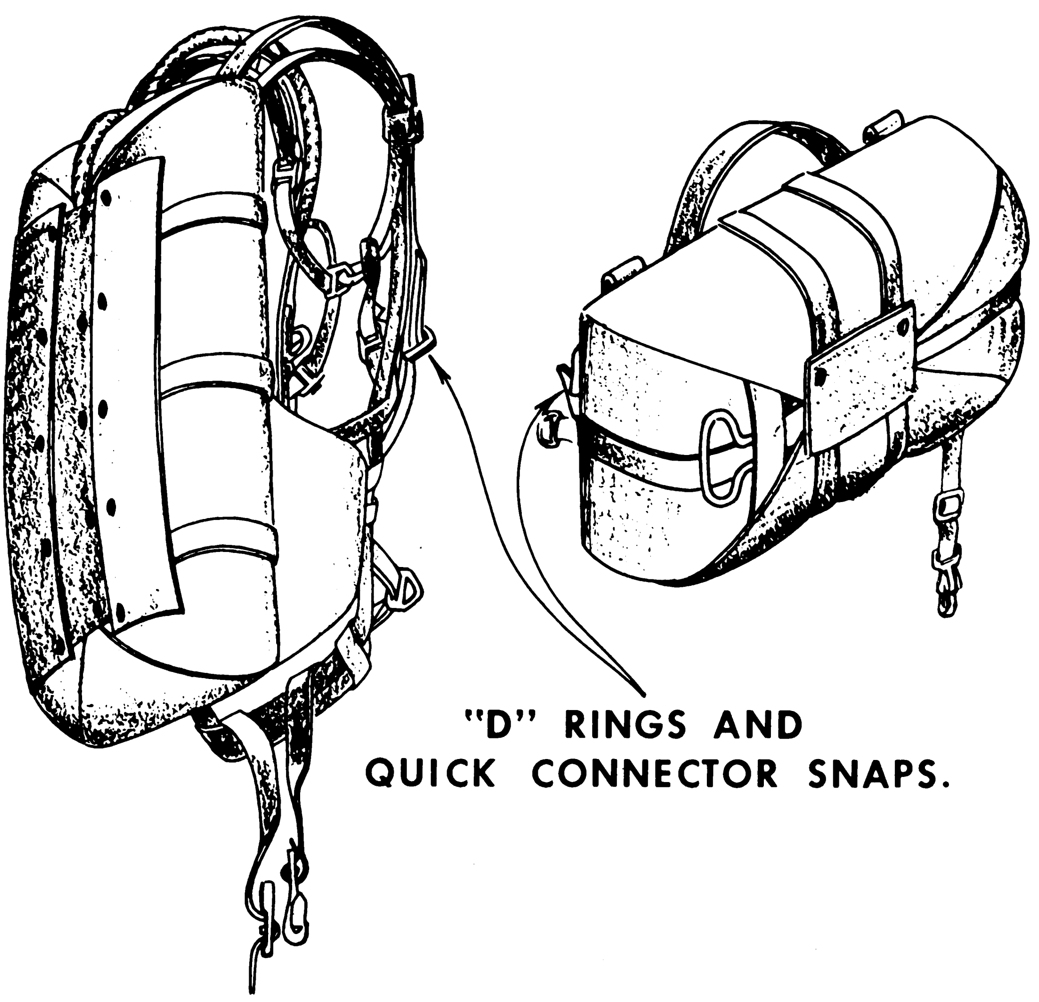


Figure 2-13.—Troop type parachute assembly.

The five major parts of a standard service parachute, starting at the top and working down, are pilot chute, canopy, suspension lines, harness, and pack. These are shown in figure 2-14. This parachute has the regular size harness and a 28-foot ripstop nylon canopy.

PILOT CHUTE

The vane type pilot chute is used on all Navy parachutes.

Figure 2-15 shows the nomenclature or names of parts and materials that make up a pilot chute. A knowledge of this nomenclature and materials will prove valuable in your future work with parachutes.

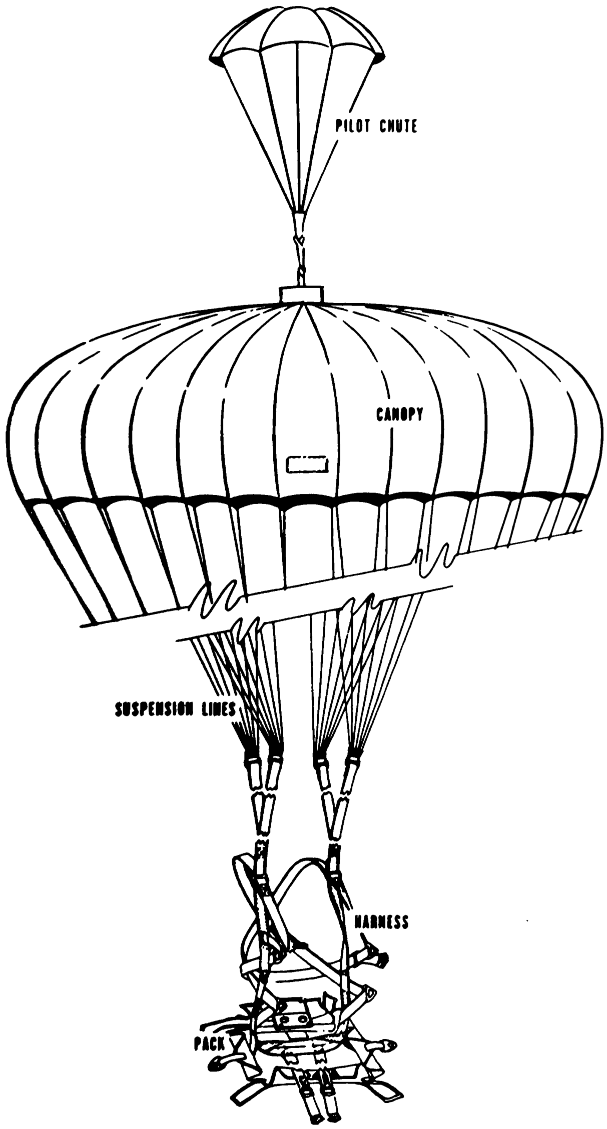


Figure 2-14.—The five major parts of a parachute.

CANOPIES

The size and shape of the parachute canopy has been a controversial subject ever since Leonardo da Vinci envisioned a pyramid of cloth as being the answer to a safe method of descent. Today the use of the parachute has been greatly broadened, but the overall acceptance of a reliably designed canopy has narrowed on two shapes. One is the old and proved reliable, standard flat type design, which has remained unchanged, except for minor revisions, for the past 30 years. The second is a new idea in construction but still follows the basic shape pattern. This type is known as the 26-foot 22-gore conical canopy. This canopy is used in the NB-5 and NB-6 (regular and oversize) parachute assemblies. The ''conical'' reference comes from the fact that the peak of the canopy is conical in construction. In descent the conical canopy presents a slightly raised shape at the apex, but fails to radically change the basic appearance so familiar to the service.

Standard Flat Type

The 28-foot ripstop nylon canopy is the old standard size used on all Navy parachutes. The parachute sail or canopy is described as a polygon having 28 sides, a diameter of 28 feet ±1 inch, and 28 gores of 4 sections each.

It has been established that the purpose of the parachute is to retard the fall of the jumper or descending object. We have also seen that the canopy is designed to absorb the opening shock without tearing. This explains the necessity for care and precision in canopy construction.

The 28-foot canopy requires approximately 796 square feet of nylon cloth plus 2,400 yards of nylon thread. The sewing on a parachute varies from 8 to 11 stitches per inch.

From the above we can determine interesting bits of information. A parachute canopy contains approximately half a million stitches. The area of the canopy is as great or greater than many two-bedroom homes. A complete parachute outfit ranges in price, depending on the type, from $140 to $300 apiece. That's little enough to pay for such a vast amount of safety.

Figures 2-16 and 2-17 illustrate the 28-foot flat canopy. Note that suspension lines run continuously without splices, knots or twists from connector link to connector link.

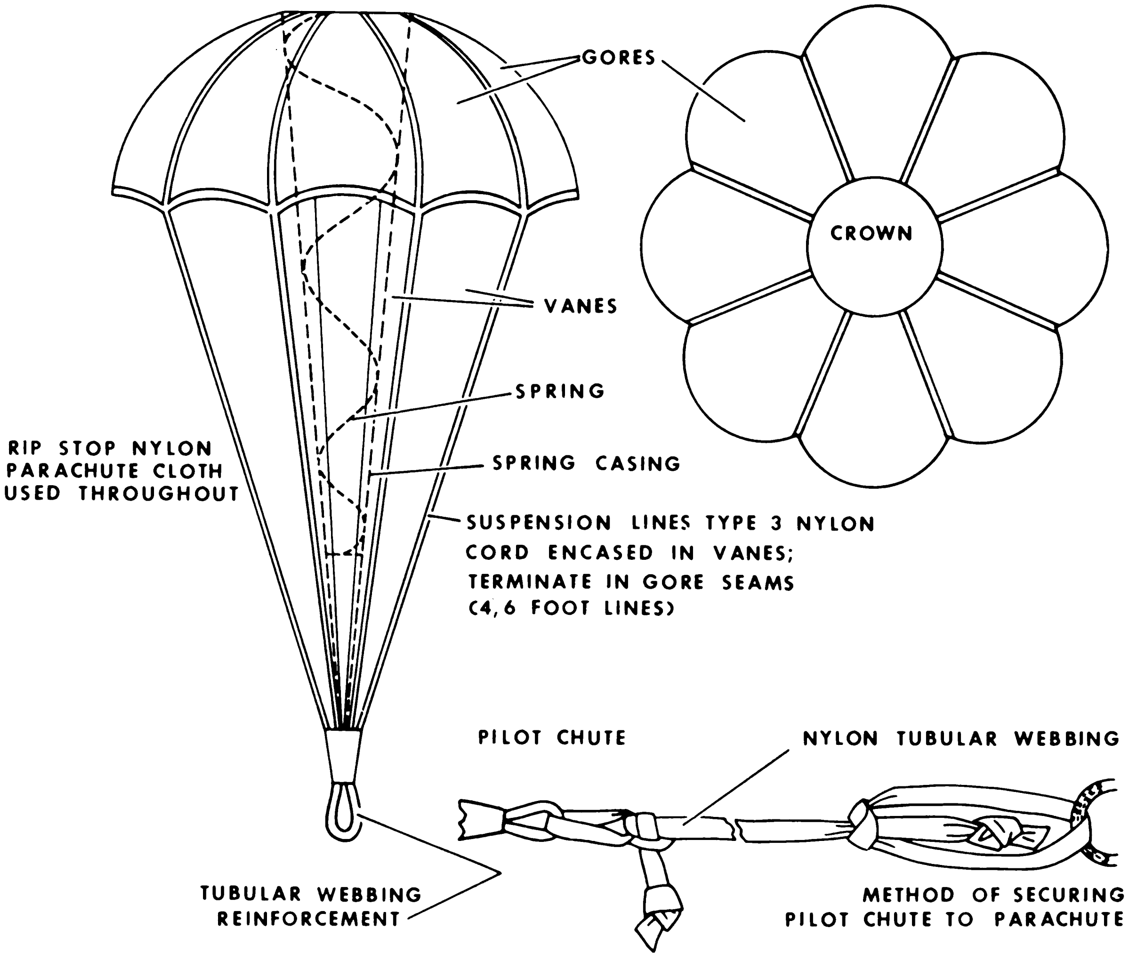

GORES
CROWN
VANES
SPRING
RIP STOP NYLON PARACHUTE CLOTH USED THROUGHOUT
SPRING CASING
SUSPENSION LINES TYPE 3 NYLON CORD ENCASED IN VANES; TERMINATE IN GORE SEAMS (4,6 FOOT LINES)
PILOT CHUTE
NYLON TUBULAR WEBBING
TUBULAR WEBBING REINFORCEMENT
METHOD OF SECURING PILOT CHUTE TO PARACHUTE

Figure 2-15.—The vane type pilot chute.

The following additional items concerning standard flat canopies should be remembered:

1. Each gore is composed of four sections identified by the letters A, B, C, and D, starting from the bottom.

2. Diagonal seams run parallel to the warp thread in the cloth; the warp changing direction with each gore. These sections are cut at a 45-degree angle to the centerline of the gore. This is called BIAS CONSTRUCTION and provides the maximum strength and elasticity in the unit.

3. Radial and diagonal seams are double-lapped for security. The radial seams enclose the suspension lines in the channels produced by the stitching.

4. The skirt and vent hems are reinforced with 1-inch nylon webbing. Tubular nylon webbing is installed in the vent to help prevent a tear from completely separating the canopy, and nylon webbing is installed in the skirt hem for the same reason.

5. The vent ring must expand from 4 inches to 18 inches in diameter. This is the maximum vent opening under air pressure. The vent acts as a safety valve and aids in relieving high internal pressure within the inverted, cup-shaped, parachute at the moment of opening. In normal descent, the air, not relieved by the vent, spills out of the sides and creates a certain amount of oscillation. Without a vent, parachute openings at high speed could result in a severe rupture of the canopy.

6. The following is stenciled on the top center gore (section A of number 28 gore) in letters 1/2 inch high and approximately 12 inches from the bottom of the canopy:

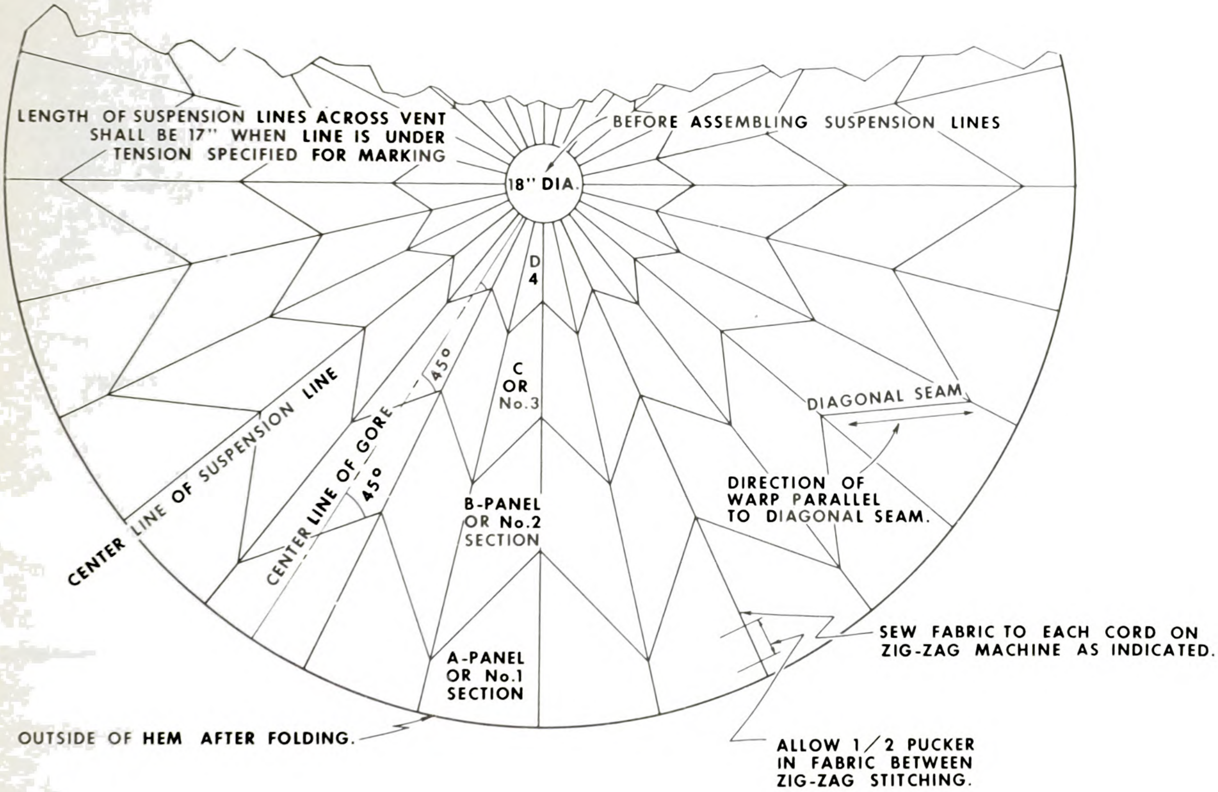

LENGTH OF SUSPENSION LINES ACROSS VENT SHALL BE 17" WHEN LINE IS UNDER TENSION SPECIFIED FOR MARKING
BEFORE ASSEMBLING SUSPENSION LINES
18" DIA.
D
4
C
OR
No.3
45°
CENTER LINE OF SUSPENSION LINE
CENTER LINE OF GORE
45°
B-PANEL
OR No.2
SECTION
DIAGONAL SEAM
DIRECTION OF WARP PARALLEL TO DIAGONAL SEAM.
SEW FABRIC TO EACH CORD ON ZIG-ZAG MACHINE AS INDICATED.
A-PANEL
OR No.1
SECTION
OUTSIDE OF HEM AFTER FOLDING.
ALLOW 1/2 PUCKER IN FABRIC BETWEEN ZIG-ZAG STITCHING.

Figure 2-16.—The 28-foot ripstop nylon canopy.

NAVAIRFAC
ORDER NO.
DATE OF MANUFACTURE AND SERIAL NO.
MANUFACTURER'S NAME OR TRADE MARK.

Stenciled on the diametrically opposite gore (section A of number 14 gore) is found the following:

DATE OF MANUFACTURE AND SERIAL NO.

7. All marking fluid used shall be in accordance with Specification MIL-F-6903.

8. All machine stitching, except zigzag, shall conform to Type 301, Specification DDD-S-751, and not be less than 8 nor more than 11 stitches per inch.

9. Ends of all tape, webbing, and lines shall be seared to prevent fraying. No waxes shall be used.

10. For sewing diagonal seams, size B or E nylon thread may be used. Use size E nylon thread for all other seams, zigzag stitching, and repairs.

11. Removable connector links provide a quick attachment of the canopy and suspension lines to the harness.

Conical Canopy

Figure 2-18 illustrates the conical canopy designed like the 28-foot flat canopy to absorb opening shocks in excess of 8,000 pounds. A parachute rigged with this canopy is reduced in bulk, offers greater stability and a faster opening, and has a slightly higher average rate of descent (22 feet per second).

Note the construction differences:

1. Shape.
2. Suspension lines are anchored to the canopy at the skirt and are not continuous from link to link. This reduces the bulkiness of the parachute.
3. Reinforcing bands of tape are located around the circumference starting at the top of section No. 2.
4. The conical canopy does not have a vent collar, but does have a vent cover.

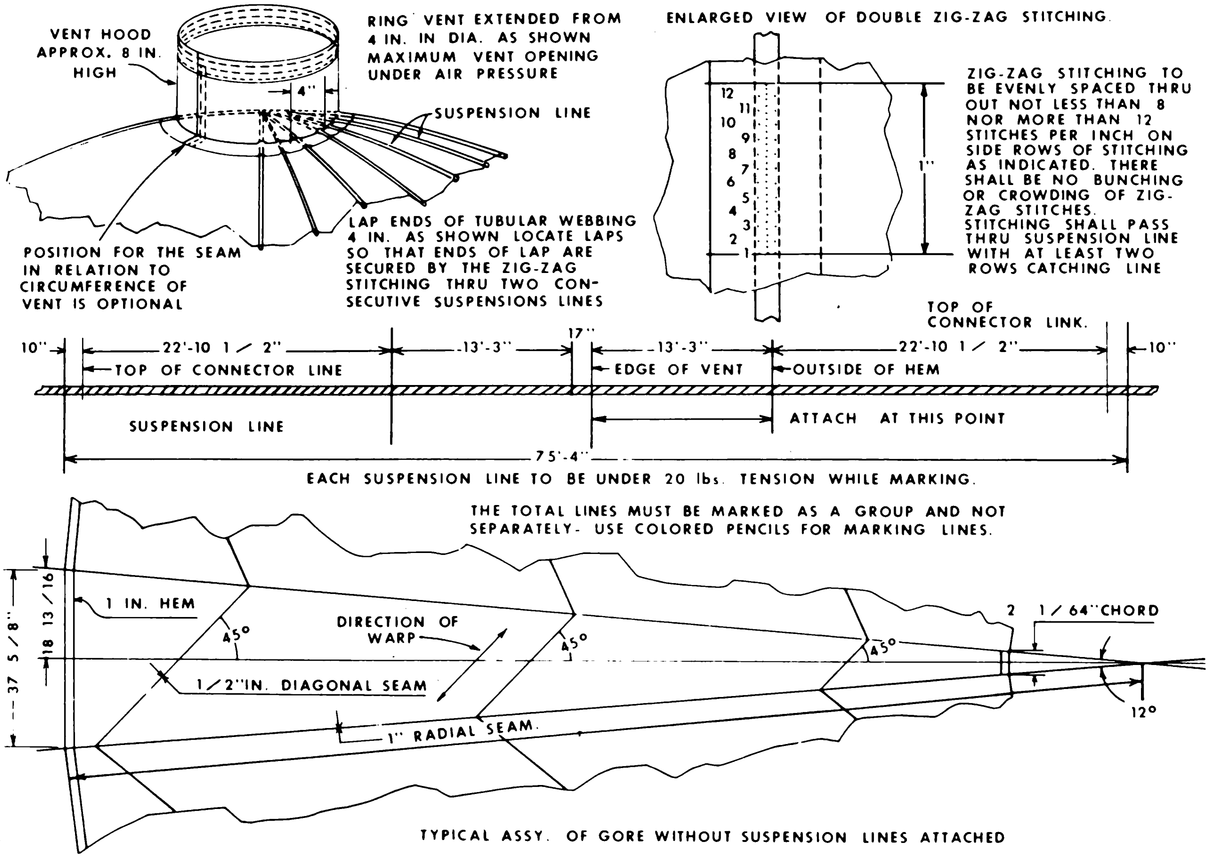

VENT HOOD APPROX. 8 IN. HIGH
4"
RING VENT EXTENDED FROM 4 IN. IN DIA. AS SHOWN MAXIMUM VENT OPENING UNDER AIR PRESSURE
SUSPENSION LINE
POSITION FOR THE SEAM IN RELATION TO CIRCUMFERENCE OF VENT IS OPTIONAL
LAP ENDS OF TUBULAR WEBBING 4 IN. AS SHOWN LOCATE LAPS SO THAT ENDS OF LAP ARE SECURED BY THE ZIG-ZAG STITCHING THRU TWO CONSECUTIVE SUSPENSIONS LINES
ENLARGED VIEW OF DOUBLE ZIG-ZAG STITCHING.
12
11
10
9
8
7
6
5
4
3
2
1
1"
ZIG-ZAG STITCHING TO BE EVENLY SPACED THRU OUT NOT LESS THAN 8 NOR MORE THAN 12 STITCHES PER INCH ON SIDE ROWS OF STITCHING AS INDICATED. THERE SHALL BE NO BUNCHING OR CROWDING OF ZIG-ZAG STITCHES. STITCHING SHALL PASS THRU SUSPENSION LINE WITH AT LEAST TWO ROWS CATCHING LINE
TOP OF CONNECTOR LINK.
10"
22'-10 1/2"
TOP OF CONNECTOR LINE
13'-3"
17"
13'-3"
EDGE OF VENT
OUTSIDE OF HEM
22'-10 1/2"
10"
SUSPENSION LINE
ATTACH AT THIS POINT
75'-4"
EACH SUSPENSION LINE TO BE UNDER 20 lbs. TENSION WHILE MARKING.
THE TOTAL LINES MUST BE MARKED AS A GROUP AND NOT SEPARATELY- USE COLORED PENCILS FOR MARKING LINES.
37 5/8"
18 13/16
1 IN. HEM
45°
DIRECTION OF WARP
45°
45°
1/2"IN. DIAGONAL SEAM
1" RADIAL SEAM.
2 1/64"CHORD
12°
TYPICAL ASSY. OF GORE WITHOUT SUSPENSION LINES ATTACHED

Figure 2-17.—The 28-foot ripstop nylon canopy—continued.

5. There are 22 gores, the joining of which requires fewer seams and is less bulky.
6. The strength and the stability of the parachute are increased; but the rate of descent has been sacrificed to a certain degree for the apparent emphasis on less bulk.

SUSPENSION LINES

The suspension lines form a net or skeleton for the canopy and absorb a portion of the shock load.

Suspension lines are marked and cut as a group under a 20-pound tension since all lines must be equal in length. It takes 75 feet 4 inches of line to complete the connection from link to link on a 28-foot canopy. The 28 suspension lines counted at the links are actually 14 continuous unbroken lines.

The sleeve is a loosely woven covering protecting several inner cords or strands called the CORE. The greatest strength comes from the inner cords. One or more cords are often colored in accordance with a code to identify the manufacturer. Type III nylon suspension line is used on all main canopies and on the vane type pilot chute.

Figure 2-19 illustrates the attachment of suspension lines to removable connector links. Also shown is the arrangement of the suspension lines on the 26-foot 22-gore canopy. The 28 suspension lines are distributed in four groups of seven-lines each and each group of lines is secured to a connector link as shown in figure 2-20.

To prevent the canopy (28-foot) from slipping along the suspension lines, each line is anchored by zigzag stitching at several points to the radial seams through which it passes. One-half inch of slack is allowed in the vicinity of the skirt between the zigzag sewing points to relieve the strain during opening shock. This is necessary as the suspension lines have a greater percentage of elongation than the canopy fabric.

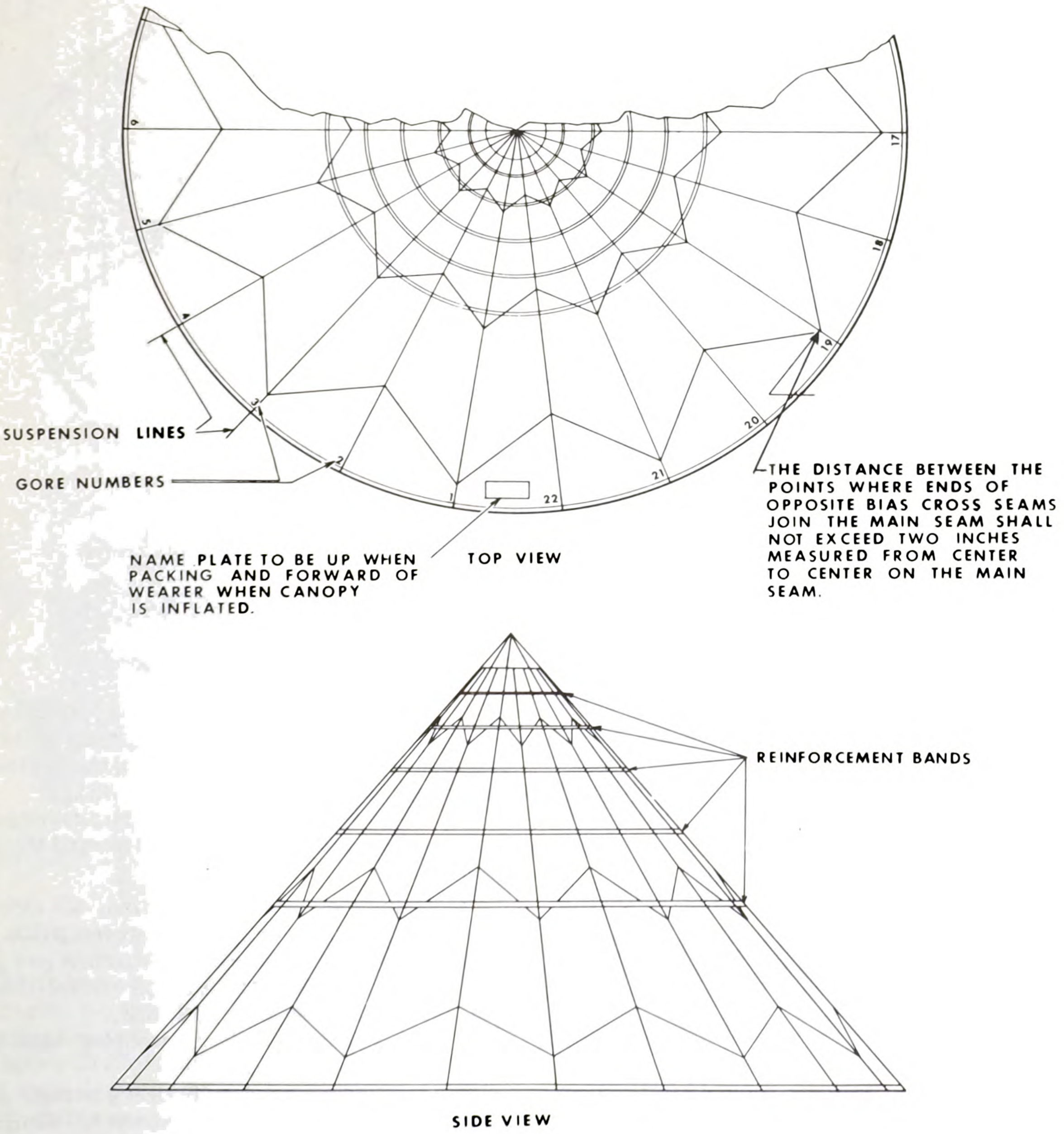

6
5
4
3
2
1
22
21
20
19
18
17
SUSPENSION LINES
GORE NUMBERS
NAME PLATE TO BE UP WHEN PACKING AND FORWARD OF WEARER WHEN CANOPY IS INFLATED.
TOP VIEW
THE DISTANCE BETWEEN THE POINTS WHERE ENDS OF OPPOSITE BIAS CROSS SEAMS JOIN THE MAIN SEAM SHALL NOT EXCEED TWO INCHES MEASURED FROM CENTER TO CENTER ON THE MAIN SEAM.
REINFORCEMENT BANDS
SIDE VIEW

Figure 2-18.—Conical canopy, 26-foot 22-gore.

HARNESS

The purpose of the harness is to form a sling or swing in which the wearer may sit without danger of separation from the parachute.

All conventional Navy parachute harnesses are the quick fit type, and are easily adjusted by the individual wearer. Figure 2-21 illustrates the seat type harness.

This harness like all other harnesses is available in an oversize model. The oversize model is not illustrated. The dimensions in inches are listed below:

	NS-3R	NS-3O
End of sling reinforcing strap.	1-3/4 x 12	1-3/4 x 12
Liferaft retainer strap.	1-3/4 x 24	1-3/4 x 24
Adjusting strap	1-3/4 x 27	1-3/4 x 38
Back strap	1-3/4 x 35	1-3/4 x 36
Leg and body strap	1-3/4 x 100	1-3/4 x 117
Sling strap	1-3/4 x 184	1-3/4 x 196

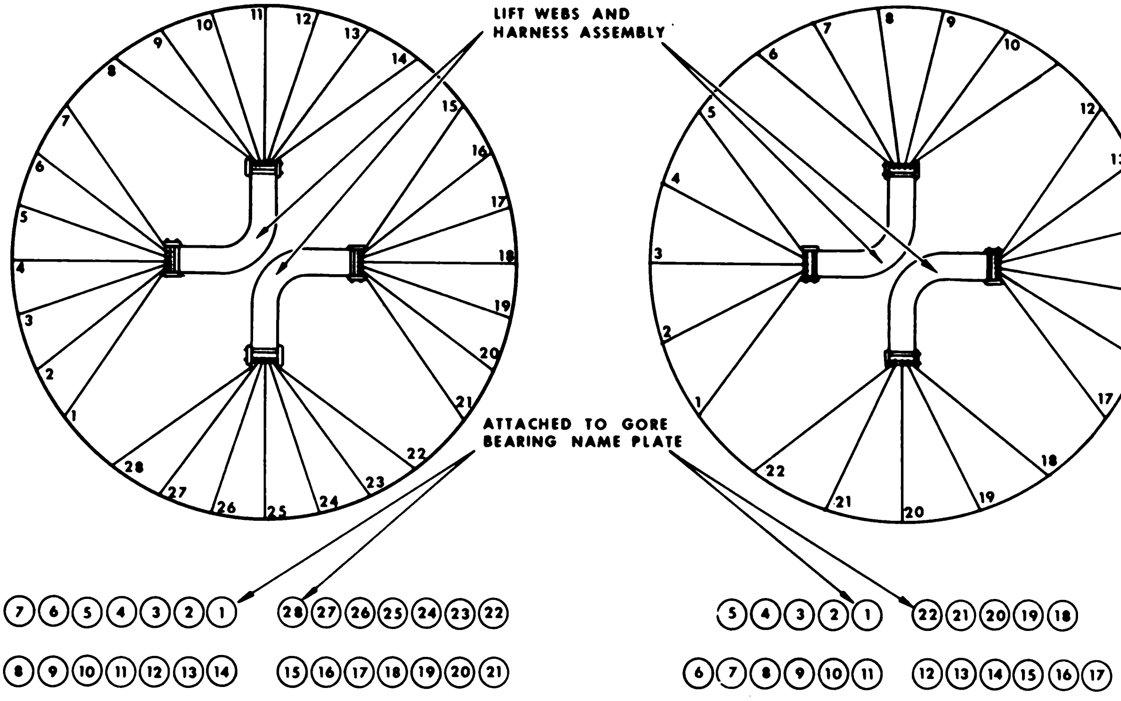

LIFT WEBS AND HARNESS ASSEMBLY
ATTACHED TO GORE BEARING NAME PLATE
⑦⑥⑤④③②①
㉘㉗㉖㉕㉔㉓㉒
⑧⑨⑩⑪⑫⑬⑭
⑮⑯⑰⑱⑲⑳㉑
⑤④③②①
㉒㉑⑳⑲⑱
⑥⑦⑧⑨⑩⑪
⑫⑬⑭⑮⑯⑰

Figure 2-19.—Method of attaching suspension lines to connector links.

A soft weave nylon webbing is in use as the older hard webbing stock is approaching depletion, thus ending one of the major complaints against the uncomfortable nylon harness. This new soft webbing conforms with the General Textile Mills, Style 322A.

Figure 2-22 illustrates the back type harness which is very similar to the seat type.

The differences are purely dimensional and are in the leg and body straps and main sling.

Figure 2-23 illustrates the chest type harness. This harness is the only one adaptable to the quick attachable chest parachute. The lift web assembly (fig. 2-24) is secured to the canopy by suspension lines in the same manner as the lift webs of a fixed type harness. The pack is attached to the harness by using a positive upward motion and engaging the connector snaps of the lift webs with the connector links of the harness.

The cross connector or safety strap of the lift web assembly is a very important item. It prevents the collapse of the canopy should only one connection be made.

From the above discussion of harness and the types of harness, the following facts are summarized:

1. The date of manufacture, month and year, should be stamped with marking fluid in letters 1/2 inch high on either the inside of the horizontal backstrap or on the inside of the sling.
2. All harness snaps are to be assembled so that the open side of the snap is toward the body when worn.
3. Unless otherwise specified, all machine stitching is to be 6-cord sage green nylon with not less than 4 nor more than 6 stitches per inch. Ends of all stitching should be backstitched a distance of not less than 1/2 inch.
4. All exposed ends of webbing should be seared to prevent fraying.
5. The snaps used on both leg straps differ from those used on the chest strap. Quick-fit adapters are employed on the harness. Both of the upper leg strap extensions carry triangle links. Triangle links were formerly called V-rings.
6. The troop type harness is a combination harness adaptable to the quick attachable NT-4 and the NT-4R. The parachute carries the harness designation and in this case it is an "R" or regular size harness. This harness has not been illustrated, as other illustrations have sufficiently covered all necessary nomenclature, design and material features.
7. All harnesses are dyed sage green or blue.

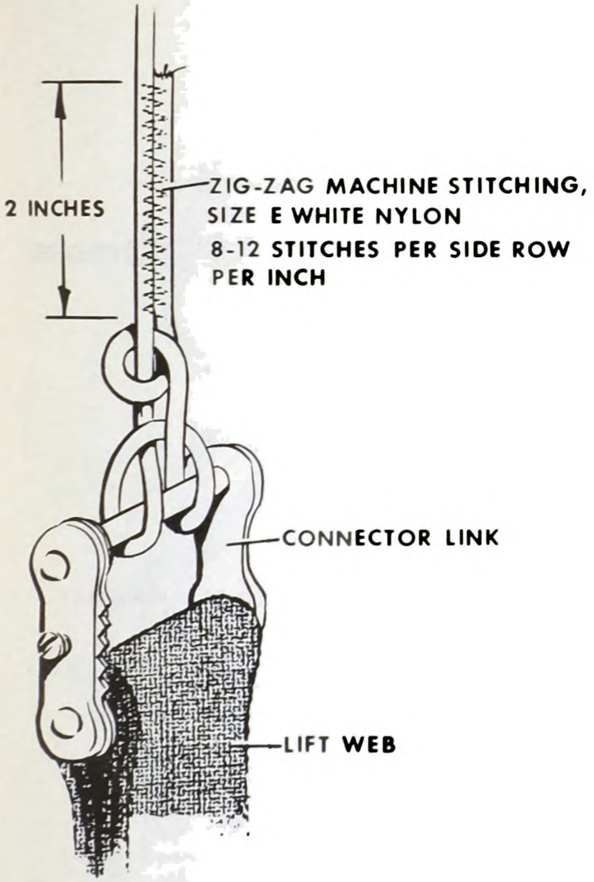


Figure 2-20.—Closeup of suspension lines at the link.

PARACHUTE CONTAINER

The purpose of the parachute pack is to house and protect the pilot chute, canopy, and suspension lines.

Figure 2-25 illustrates the seat type parachute pack designed to be used with the 28-foot, ripstop nylon canopy.

Figures 2-26, 2-27, and 2-28, illustrate the other packs employed. Careful study will show the differences.

In regard to construction of the container, the following items are to be noted:

1. The outside covering of the pack, referred to as -16 (seat pack) on the blueprint, is cut in one piece on a bias at 45 degrees to the centerline. This provides the elasticity necessary for the terrific beating to which the unit is subjected in packing and in normal use.

2. All machine stitching used is accomplished with size E, sage green, nylon thread, 6 to 10 stitches per inch. Ends of all stitching are backstitched a distance of not less than 1/2 inch.

3. Ends of webbing and tape are seared to prevent fraying.

4. The cloth used in the outside of the pack is known as type II, nylon fabric.

Many interesting facts about materials used in this work can be found in Navy, Air Force, Military, and Federal Specifications. Visit your local Technical Publication Library when you need certain specific information, or go there simply to increase your knowledge.

RIPCORDS

The ripcord is a manual releasing device. The ripcord pins, when inserted in the locking cones of the pack, hold the pack in a closed position. In testing, a pull not in excess of 22 pounds should extract the pins out of the cones. A jumper would use a much stronger pull. The ripcord assembly is composed of a grip or hand pull, a length of cable, and a number of swaged pins. This has been the standard releasing device for the past thirty years. The help of spring bands is necessary to pull the sides and ends of the pack out of the way. These opening bands are located either on the outside of the pack or enclosed between the fabric layers of the pack. For the past ten years efforts have been made to design a successful smooth pack that completely eliminates any outside obstructions.

Figure 2-29 illustrates the standard releasing device used with the seat type parachute.

Figure 2-30 illustrates the two general shapes of ripcord grips used with Navy type parachutes.

Figure 2-31 illustrates the types of ripcords used with the seat, back, chest, and training type parachutes.

In conclusion:

1. Ripcord assemblies are proof-loaded to withstand a 300-pound pull.

2. Ripcord pins conform with AN drawing number 6568-1, are trimmed to size, and polished with 0 emery cloth or other approved methods.

3. Ripcord cables are manufactured from 3/32-inch corrosion-resistant steel.

4. Hand pulls or grips are manufactured from welded steel tubing, cadmium plated for protection.

5. The cone spacing on the pack must correspond to the pin spacing of the ripcord. This spacing is standardized for each type of parachute.

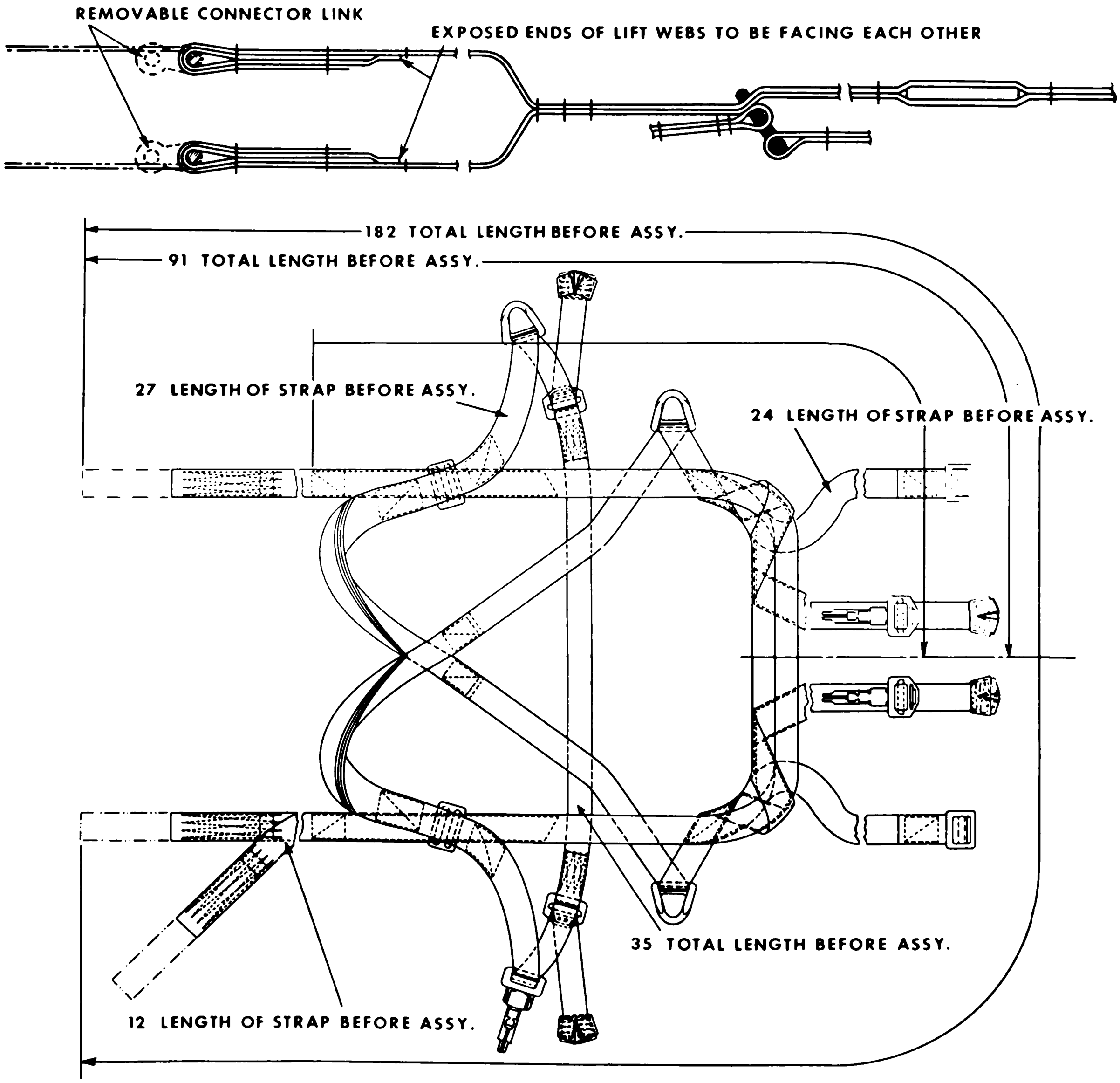

REMOVABLE CONNECTOR LINK
EXPOSED ENDS OF LIFT WEBS TO BE FACING EACH OTHER
182 TOTAL LENGTH BEFORE ASSY.
91 TOTAL LENGTH BEFORE ASSY.
27 LENGTH OF STRAP BEFORE ASSY.
24 LENGTH OF STRAP BEFORE ASSY.
35 TOTAL LENGTH BEFORE ASSY.
12 LENGTH OF STRAP BEFORE ASSY.

Figure 2-21.—Seat type harness.

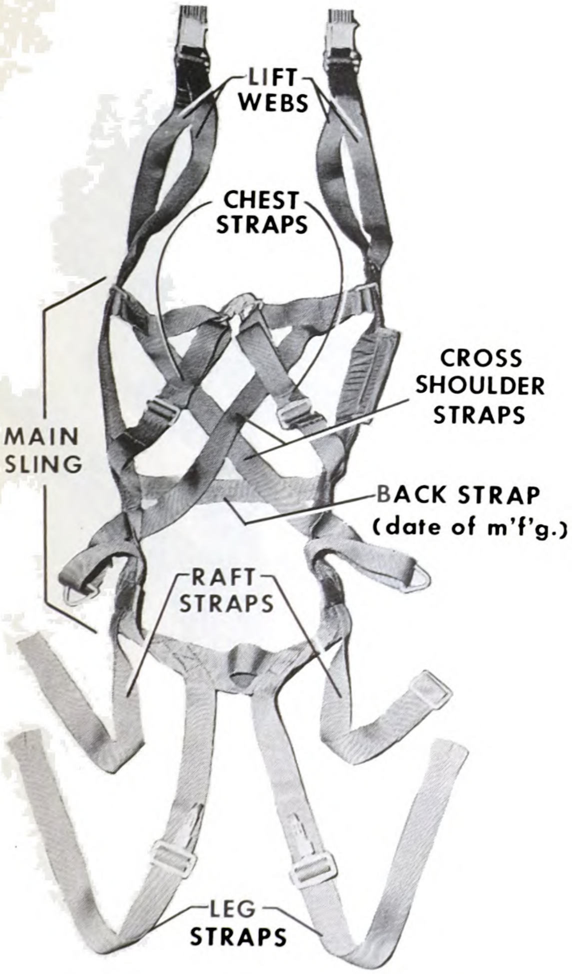


Figure 2-22.—Back type harness.

6. Ripcord pins, spacers, and ball retainers are swaged on the cable under pressure and form secure fittings.

7. The extensible ripcord used with the seat type parachute makes changing to or from the pararaft easier by eliminating the need of changing to longer or shorter ripcords.

RIPCORD HOUSINGS

Figure 2-32 illustrates the extensible ripcord housing. Note the following characteristics:

1. The length of the extensible housing when elongated to its fullest extent will measure 28-1/4 inches under 5 pounds tension. The length, when relaxed to its normal free position, will not exceed 24-1/4 inches.

2. The ferrules located on the ends of all housings are identical in design.

3. The tubing is corrosion-resistant steel.

4. NB-8 type housing is covered with a vinyl plastic.

RIPCORD GRIP POCKETS

The purpose of the pocket is to hold the grip securely to the harness, or in the case of the chest parachute, to the pack.

The other grip pockets, hand pull retainers, or elastic-rip handles (as they are termed in NAF blueprints) for the chest and training type parachutes are not shown because of their simplicity in construction. An elastic-rip handle for the service chest type parachute is manufactured from a length of elastic webbing measuring 1/8 inch thick by 1-1/2 inches wide and 6 inches long.

SEAT CUSHIONS AND BACK PADS

Seat cushions provide comfort for the wearer and are located as a cushion between the wearer and the parachute pack. When the seat and back type parachutes are rigged with the pararaft kit, the cushions are tacked to the pararaft kit container.

Back pads retain specific harness webbing straps, through the use of keepers, and also provide comfort and support for the back. The back pad further acts as a perspiration barrier when rigged to back type parachutes. (See fig. 2-33.)

PARACHUTE HARNESS HARDWARE

Figures 2-34 through 2-44 illustrate the various types of parachute harness hardware.

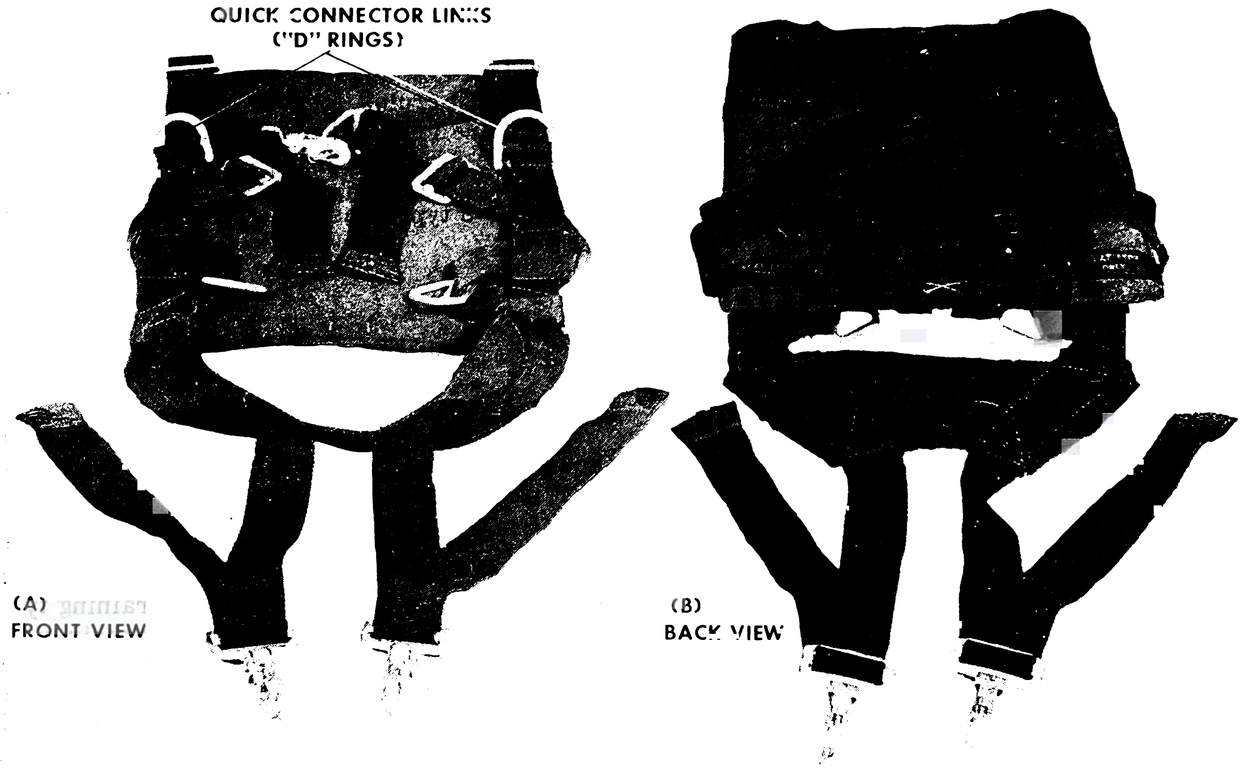


Figure 2-23 —Chest type harness.

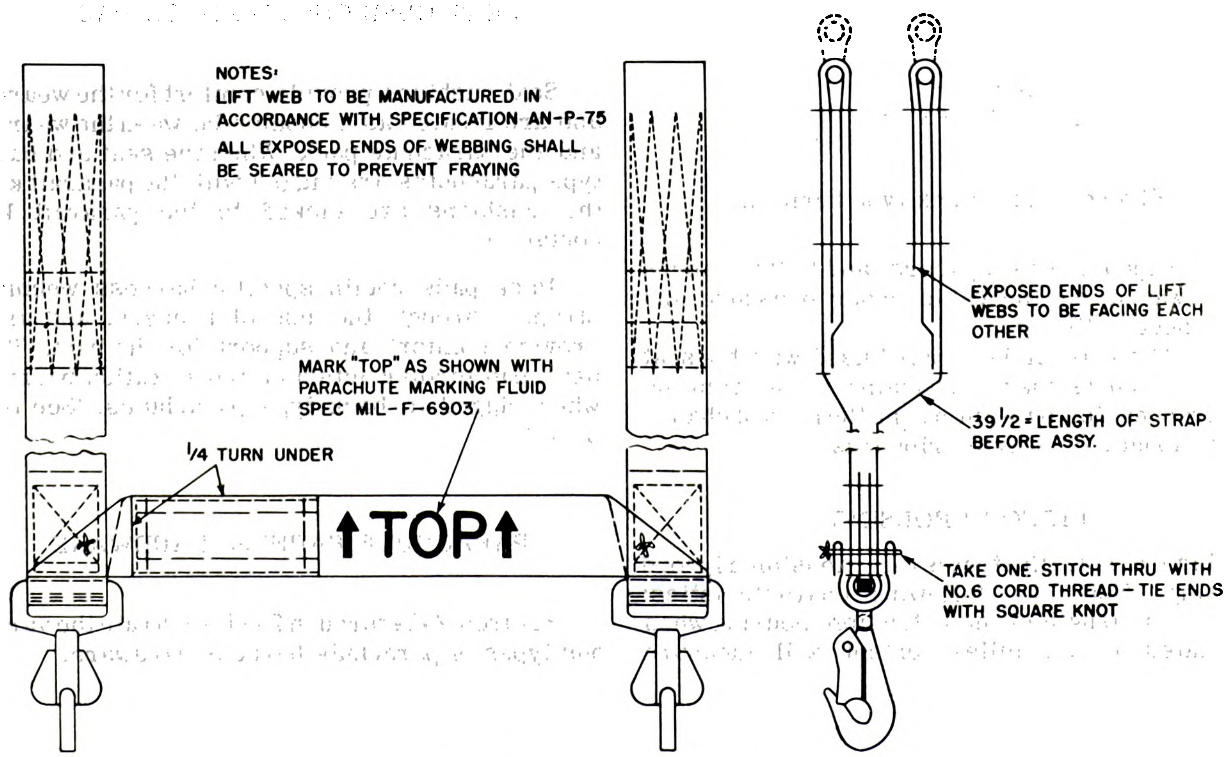

NOTES:
LIFT WEB TO BE MANUFACTURED IN ACCORDANCE WITH SPECIFICATION AN-P-75
ALL EXPOSED ENDS OF WEBBING SHALL BE SEARED TO PREVENT FRAYING
MARK "TOP" AS SHOWN WITH PARACHUTE MARKING FLUID SPEC MIL-F-6903
1/4 TURN UNDER
↑TOP↑
EXPOSED ENDS OF LIFT WEBS TO BE FACING EACH OTHER
39 1/2 = LENGTH OF STRAP BEFORE ASSY.
TAKE ONE STITCH THRU WITH NO.6 CORD THREAD - TIE ENDS WITH SQUARE KNOT

Figure 2-24.—Lift web assembly.

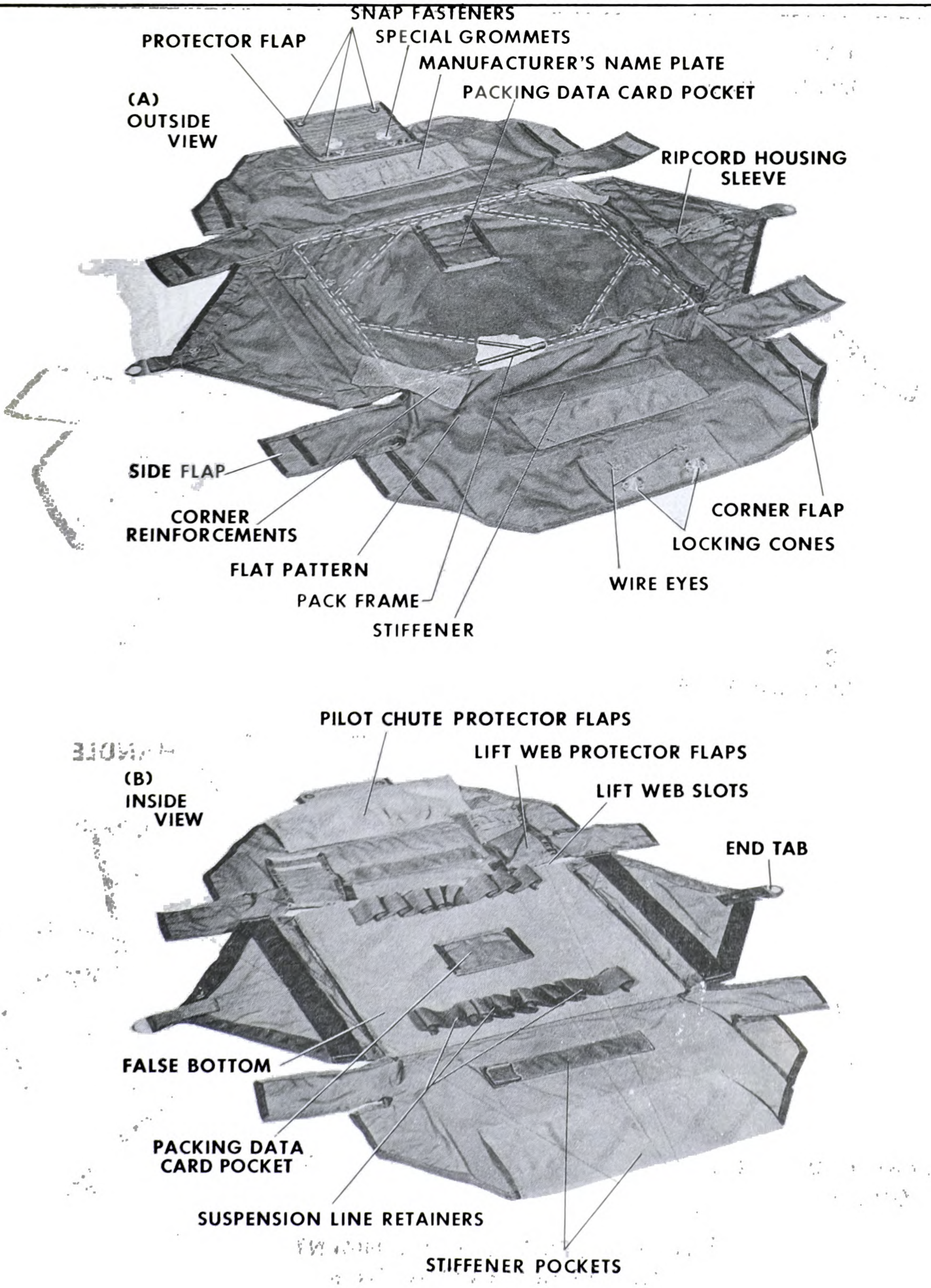
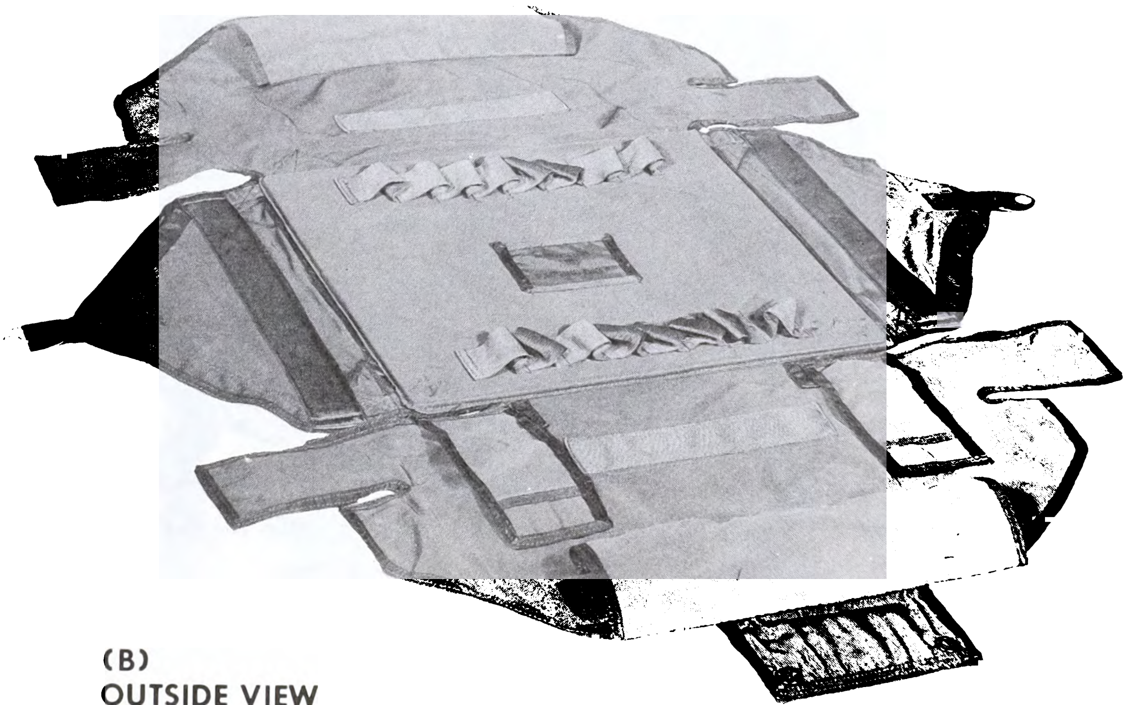


Figure 2-25.—Seat type pack.

(A)
INSIDE VIEW



(B)
OUTSIDE VIEW

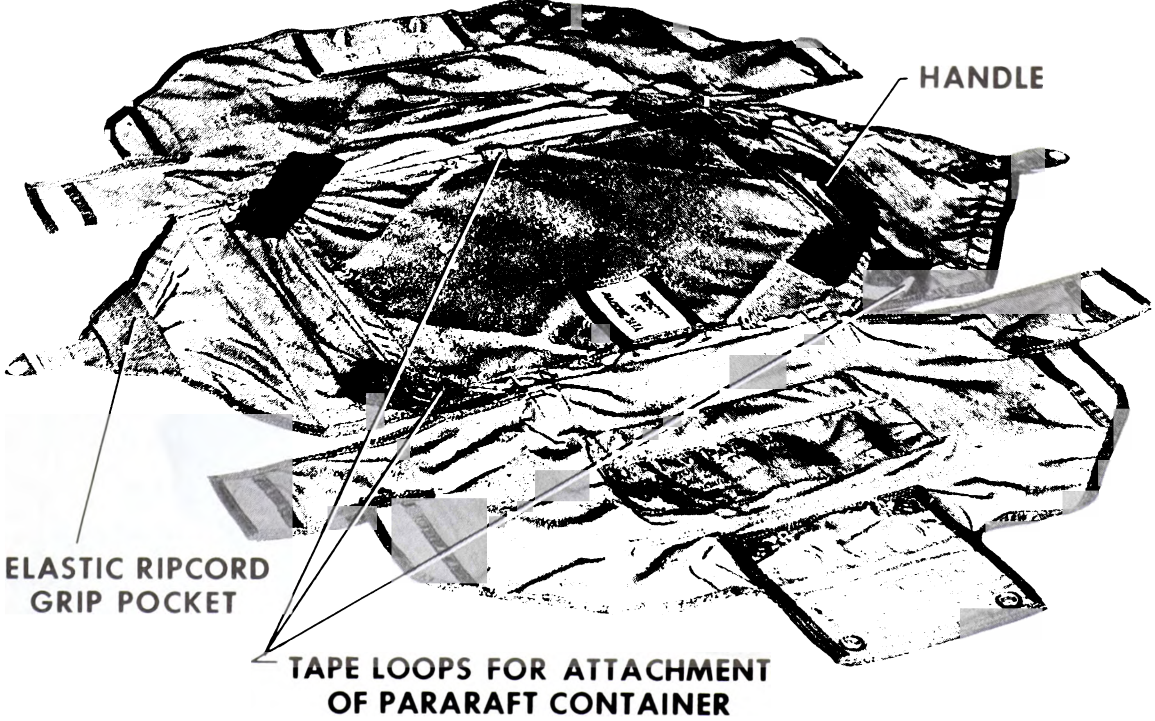

HANDLE
ELASTIC RIPCORD GRIP POCKET
TAPE LOOPS FOR ATTACHMENT OF PARARAFT CONTAINER

Figure 2-26.—Chest pack.

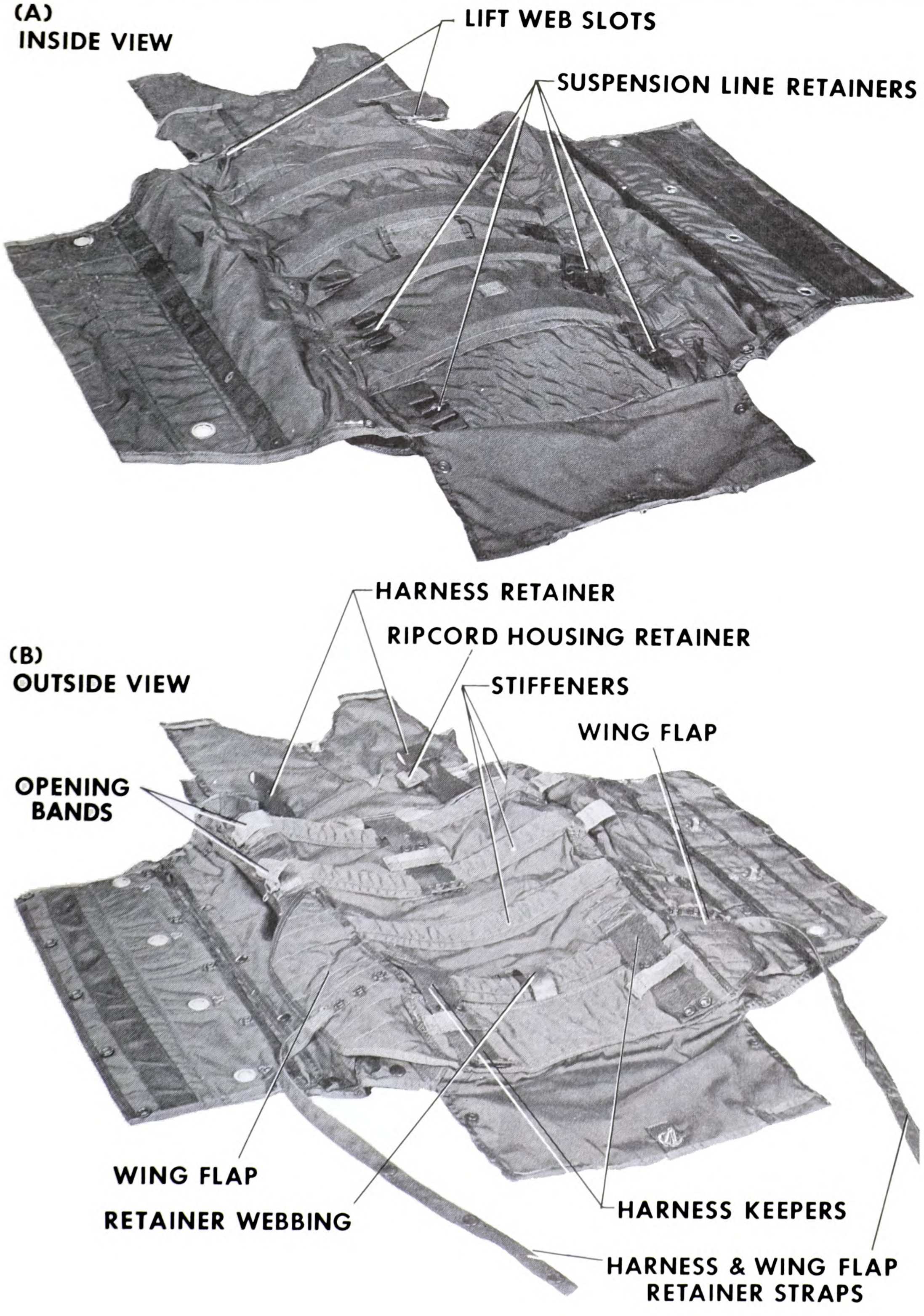
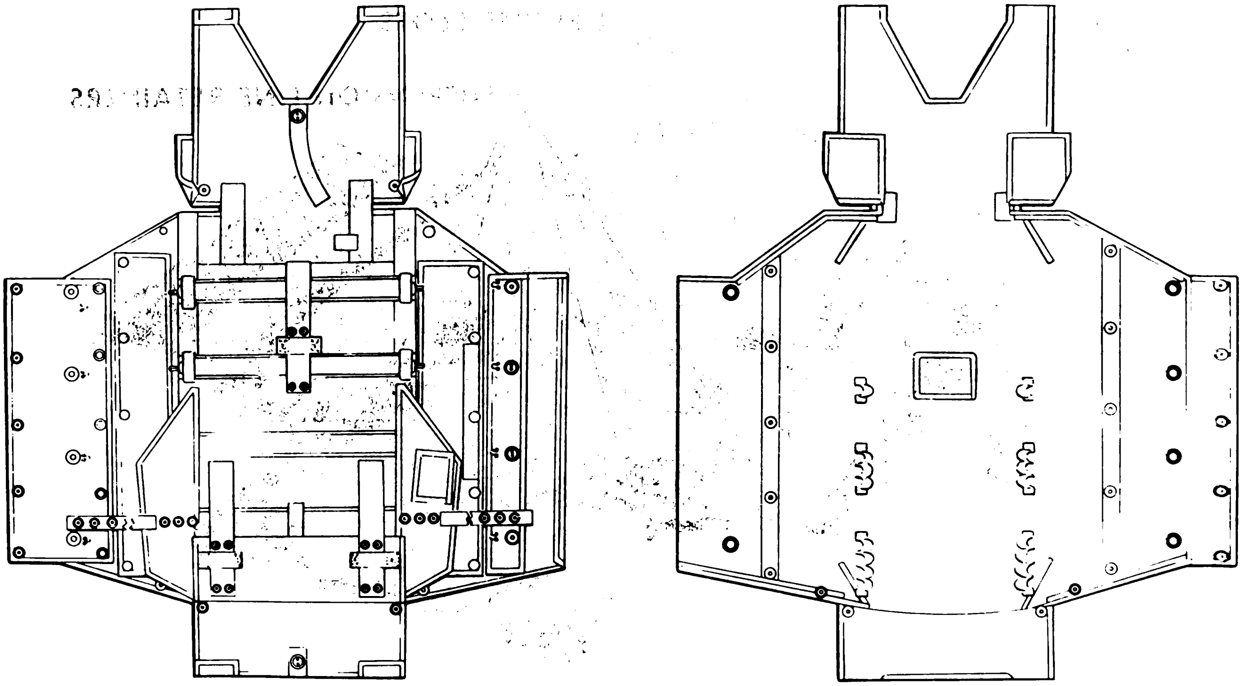


Figure 2-27.—Back pack.



(A) OUTSIDE VIEW Note similarity to BACK PACK, Fig. 2-26

(B) INSIDE VIEW

Figure 2-28.--Troop pack.

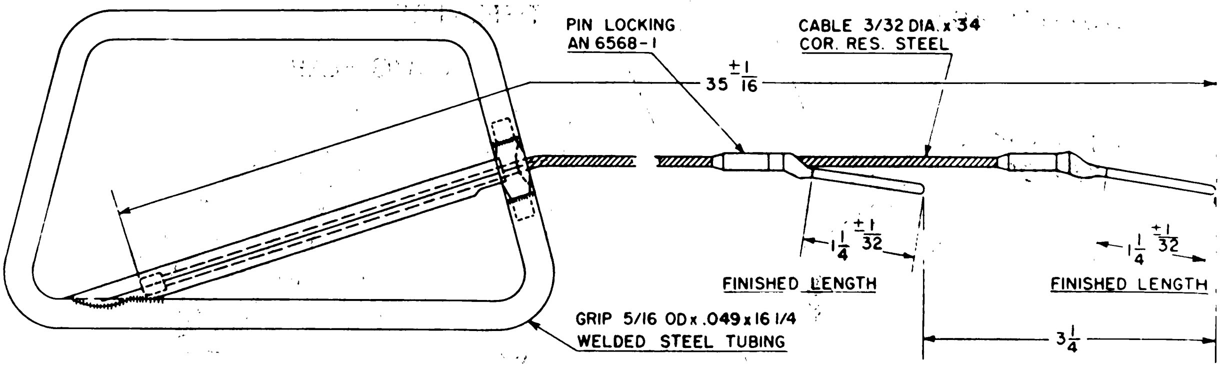
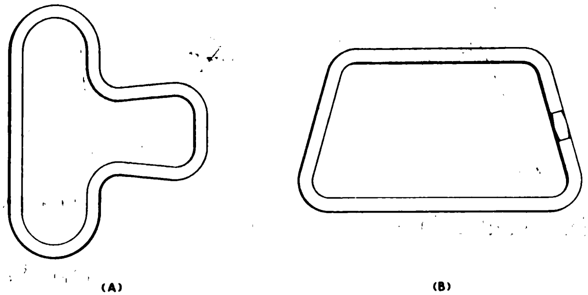


Figure 2-29.—Ripcord, extensible.



(A)

USED WITH:
CHEST TYPE PARACHUTE
TRAINING BACK TYPE PARACHUTE

(B)

USED WITH:
SEAT TYPE PARACHUTE
BACK TYPE PARACHUTE

Figure 2-30.—Ripcord grips.

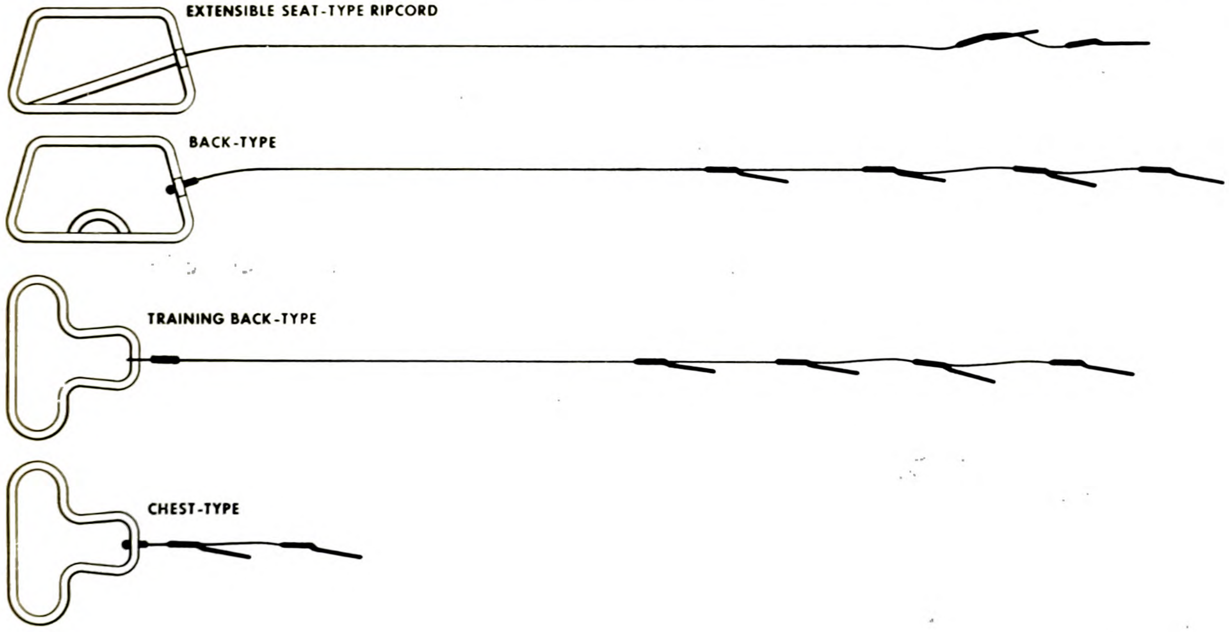


Figure 2-31.—Ripcords—back, chest, training.

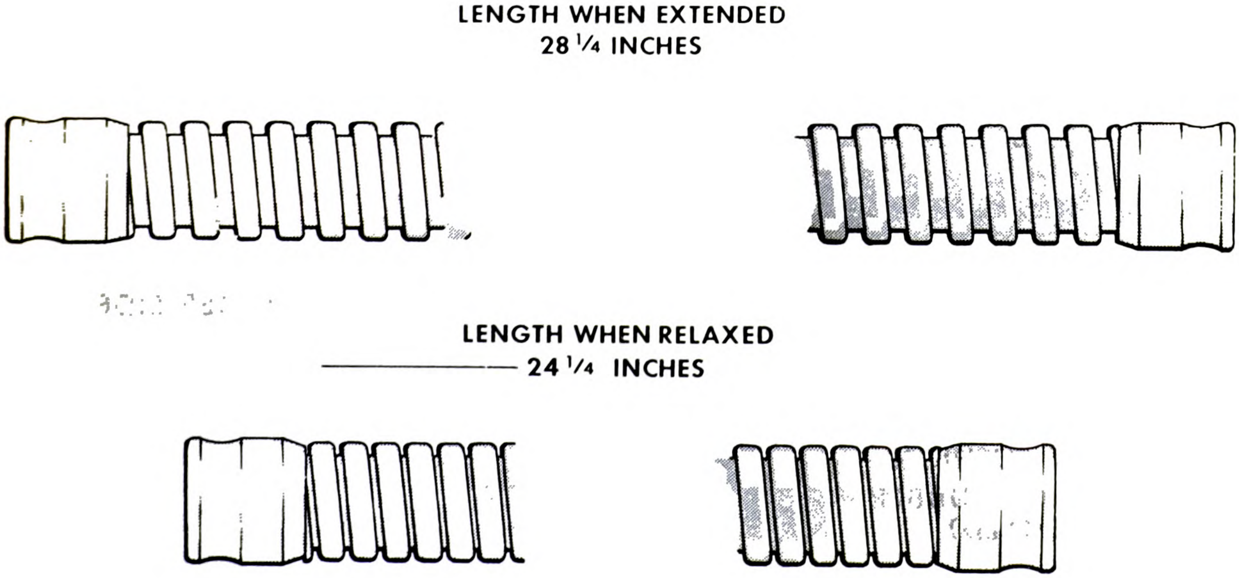


Figure 2-32.—Extensible ripcord housing.

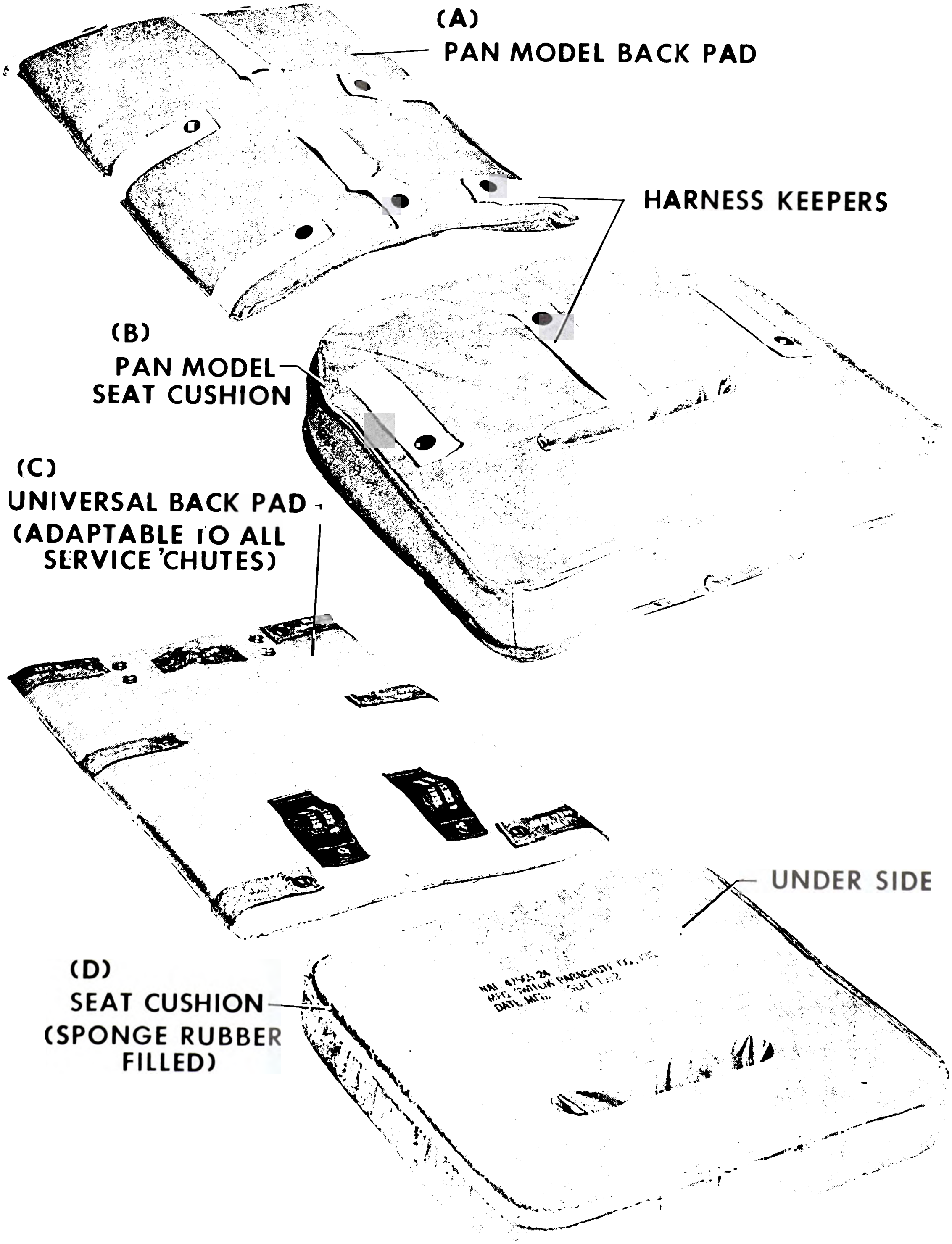

(A)
PAN MODEL BACK PAD
HARNESS KEEPERS
(B)
PAN MODEL SEAT CUSHION
(C)
UNIVERSAL BACK PAD (ADAPTABLE TO ALL SERVICE 'CHUTES)
UNDER SIDE
(D)
SEAT CUSHION (SPONGE RUBBER FILLED)

Figure 2-33.—Seat cushions and back pads.

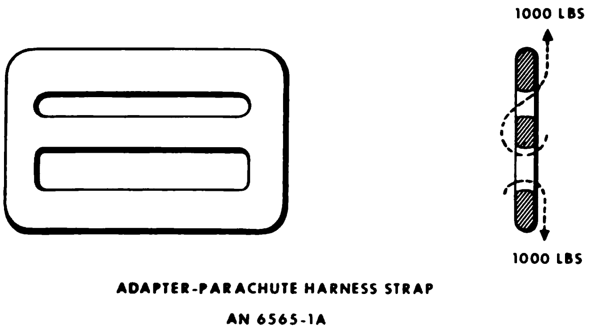


Figure 2-34.—Adapter—parachute harness strap.

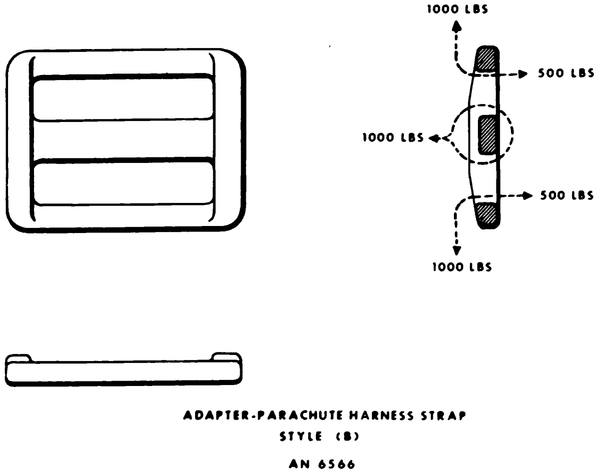


Figure 2-35.—Adapter—parachute harness strap.

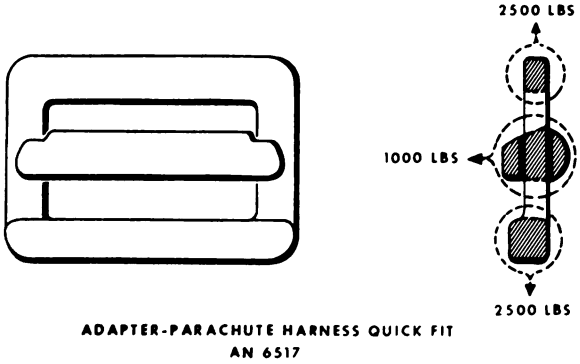


Figure 2-36.—Adapter—parachute harness quick fit.

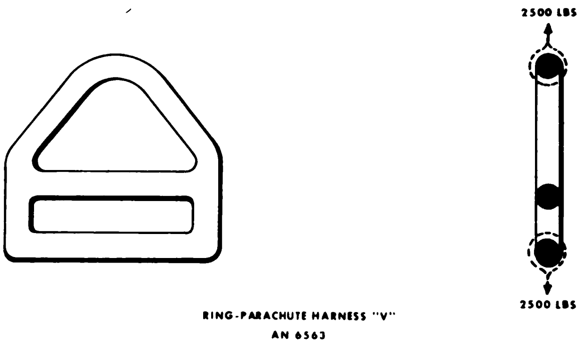


Figure 2-37.—Ring—parachute harness V.

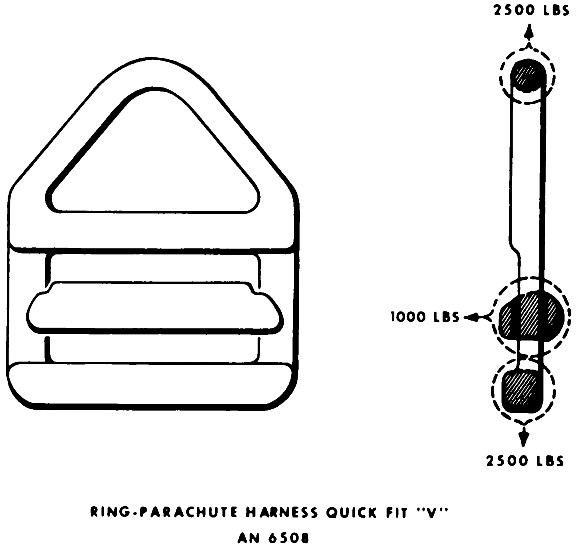


Figure 2-38.—Ring—parachute harness quick fit V.

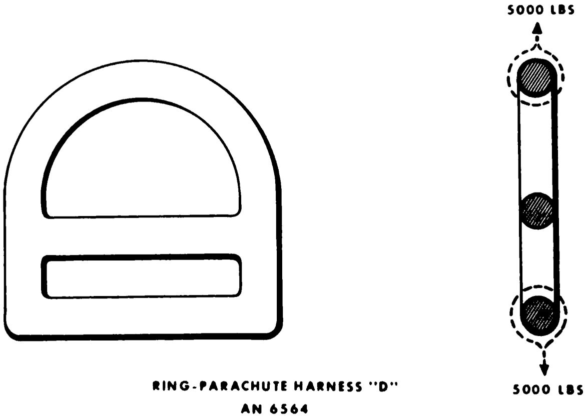


Figure 2-39.—Ring—parachute harness D.

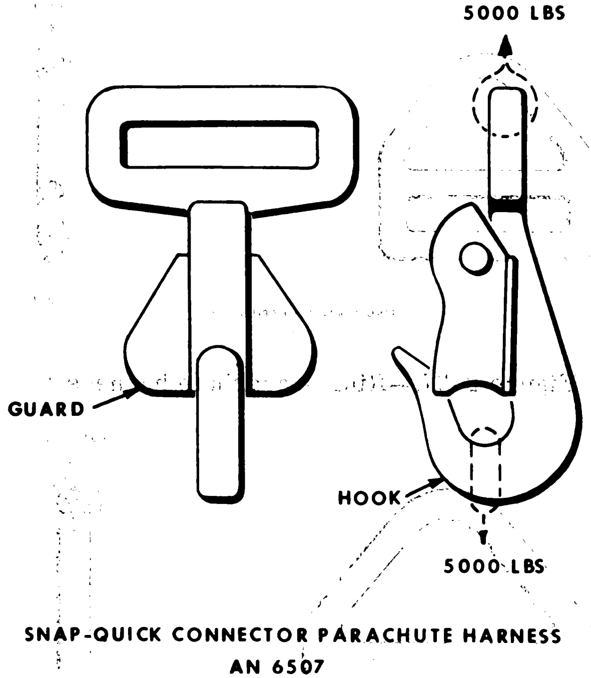


Figure 2-40.—Snap—quick connector parachute harness.

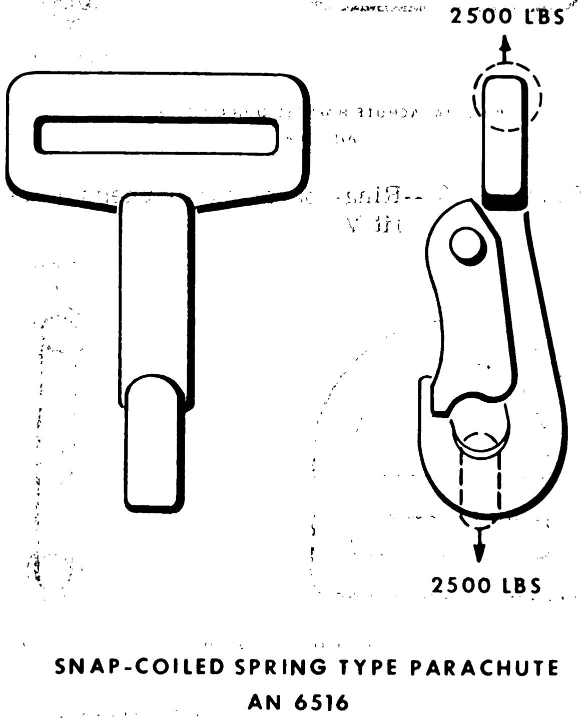


Figure 2-41.—Snap—coiled spring type parachute.

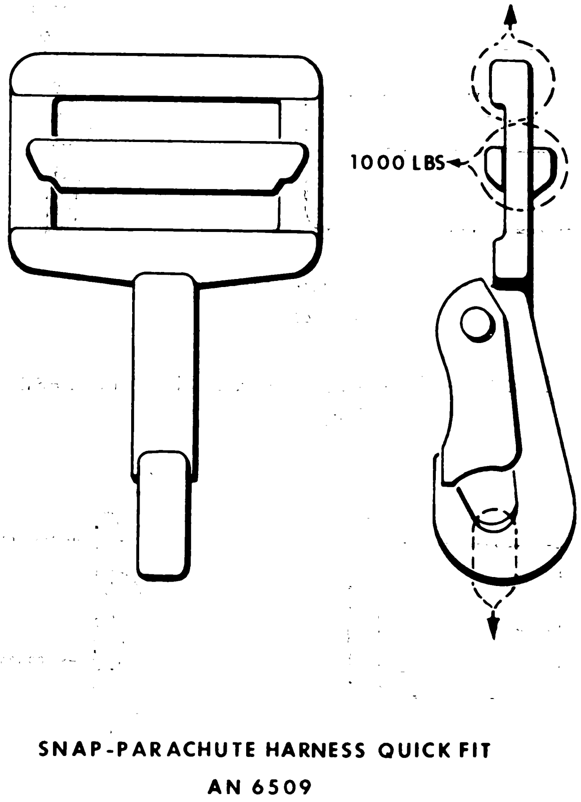


Figure 2-42.—Snap—parachute harness quick fit.

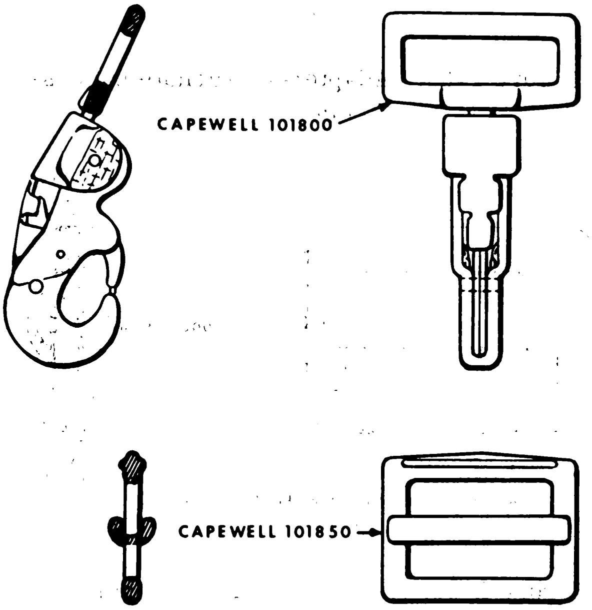


Figure 2-43.—Adapter—quick fit.

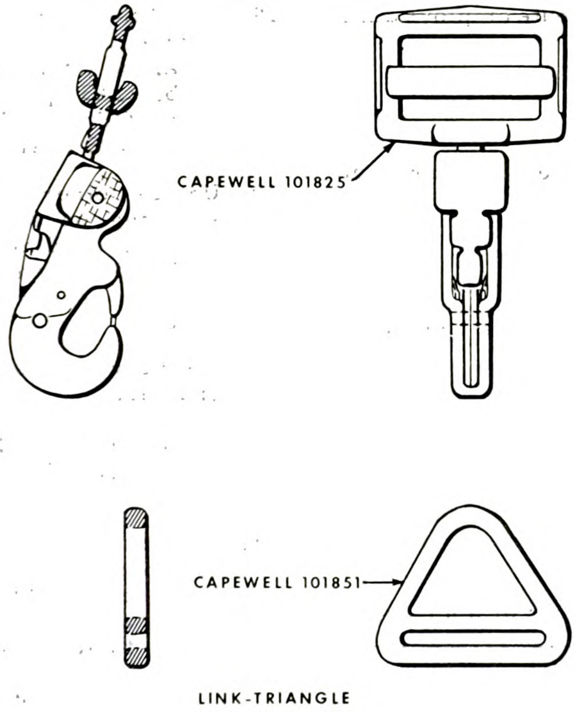


Figure 2-44.—Link—triangle.

QUIZ

1. The first design of a parachute was made by
   a. Leonardo da Vinci
   b. Fouste Veranzio
   c. Jodaki Kuparento
   d. Montgolfier
2. The first recorded emergency parachute jump was made by
   a. Leonardo da Vinci
   b. Fouste Veranzio
   c. Jodaki Kuparento
   d. Captain Albert Berry
3. The cloverleaf type ripcord handle is used on the
   a. NC-3
   b. NS-3
   c. NB-3
   d. NB-8
4. The five parts of a service parachute are canopy, pack, pilot chute, suspension lines, and
   a. vent collar
   b. false bottom
   c. harness
   d. ripcord
5. A 26-foot conical canopy has____gores.
   a. 22
   b. 26
   c. 28
   d. 14
6. On a conical canopy there are____suspension lines.
   a. 22
   b. 26
   c. 28
   d. 32
7. The stabilizer drogue chute used on a Martin-Baker parachute has a____-foot canopy.
   a. 5
   b. 15
   c. 24
   d. 26
8. The NB-5 parachute has a____-foot canopy.
   a. 22
   b. 24
   c. 26
   d. 32
9. The integrated parachute harness is used with the
   a. NB-2
   b. NB-3
   c. NB-5
   d. NB-8

10. The Martin-Baker parachute employs a ____-foot canopy.
    a. 24
    b. 26
    c. 28
    d. 32
11. The specification number of parachute marking fluid is
    a. Mil-F-6903
    b. Mil-F-6039
    c. Mil-F-6309
    d. Mil-F-6930
12. Diagonal seams in a parachute canopy are sewn with
    a. A thread
    b. B thread
    c. FF thread
    d. 24 x 4 thread
13. Diagonal seams run parallel to the
    a. salvage edge
    b. filler threads
    c. warp threads
    d. skirt hem
14. The parachute canopy is cut at a 45-degree angle and is called ____________ construction.
    a. bias
    b. straight
    c. overlap
    d. angled
15. The webbing used in the vent to prevent a tear from completely separating the canopy is ____________ webbing.
    a. reinforcing
    b. tubular
    c. parachute
    d. harness
16. On an NC-3R parachute, the "R" indicates
    a. ripcord attached
    b. regular size harness
    c. replacement harness
    d. reserve parachute
17. The chest type parachute is designed for use in VR, VP and ____________ squadrons.
    a. VF
    b. VA
    c. HU
    d. HS
18. The NS-3 parachute was first designed in 1924 and was designated as the
    a. SS (standard seat)
    b. QAS (quick attachable seat)
    c. QFS (quick fit seat)
    d. SOS (standard oversize seat)
19. Unless otherwise specified, all machine stitching on a parachute harness is with
    a. 3-cord nylon
    b. FF nylon
    c. 6-cord nylon
    d. 6-cord linen
20. To prevent fraying, all exposed harness ends are
    a. taped
    b. turned under and sewed
    c. seared
    d. waxed
21. The extensible ripcord is used with the seat type parachute
    a. to enable the use of automatic actuators
    b. to accommodate the use of a pararaft
    c. so that it may be used by different size pilots
    d. to accomplish all the above
22. When only one connector snap is fastened, the NC-3 canopy is prevented from collapsing by
    a. D-rings
    b. connector links
    c. cross connector strap
    d. suspension lines
23. All machine stitching on parachute harness is backstitched not less than ________ inch.
    a. $\frac{1}{4}$
    b. $\frac{1}{2}$
    c. $\frac{3}{4}$
    d. 1

CHAPTER 3

PARACHUTE INSPECTION

Parachute inspections must be carefully conducted to insure comfort, security, rapid positive functioning, and air worthiness of the entire assembly.

The inspection must insure comfort. Pilots and aircrewmen, with the exception of some transport crews, are required by regulations to wear either a harness or a complete parachute while in flight. Improper adjustment or rigging can cause a great amount of discomfort and bring on fatigue.

The various subassemblies of a parachute must be securely rigged so that one part will not break or tear away from another and thus jeopardize the entire unit. At the moment of the opening shock everything must hold together.

Trouble does not respect any altitude. Engine or structural failure can suddenly occur at 600 feet as well as at 6,000 feet. To insure a safe bailout at low altitude the parachute must open and open without delay.

Last of all, a parachute must be able to withstand long periods of service use. This is a vital factor, and the results lie in the hands of the Parachute Rigger and how well he performs his duties.

Factors Affecting Malfunctions

Before inspecting a parachute you must know what to look for. Even though familiar with prarachute construction, you may not find structural flaws and other details that cause malfunctioning unless you look specifically for certain imperfections.

WEAR

When inspecting for wear in a parachute assembly you look for chafing, tears, and bent or broken units. The observance of these things certainly is not difficult nor is the corrective action that follows. The important thing besides correcting the trouble is to consider its source. What caused the damage? Is the damage normal and if not, how was it inflicted? Is additional training of personnel necessary? Only upon competent authority can modification of either the parachute or aircraft bring about this correction. Do not lose sight of the possibilities for improvement.

STAINS AND DETERIORATION

Look for areas which may have come in contact with harmful foreign substances such as acid, oil, salt water, or ammonia. Stains brought on by milder substances are a common indication of deterioration. Stains generally appear as a discoloration or blemish in the material, usually distinguished by a circular or round ring. Salt water stains are characterized by the appearance of a white crystalline substance on the surface. Oil stains are recognizable by their brown-to-black color, and the oily feeling when rubbed between the fingers. Acid stains on white material appear as a greyish powdery ash. On darker materials, it tends to bleach. On all materials it causes deterioration.

An ugly stain is easily seen in a piece of fabric and usually the first thought is that the appearance of the item has been ruined. With clothes, that is true; but a stained parachute can be a threat to safety and steps must be taken to detect, neutralize, and correct the trouble before deterioration really starts.

Deterioration impairs the usefulness of any material. A suspension line must strength test at a minimum of 550 pounds, but once deterioration enters the picture we can expect a weaker line.

DISCONTINUITY OF SUSPENSION LINES

Be sure that each of the suspension lines is in correct rotation at the links and through the canopy. Insure that each unit of the assembly is in its correct position.

NONCOMPLIANCE WITH CURRENT DIRECTIVES

Is the parachute up to date? Have the latest modifications and improvements been incorporated in the design? Do not tolerate any "wild cat" modification; all justifiable local changes must first be approved by proper authority.

INCOMPLETENESS

Is the parachute complete? Regardless of how small and seemingly insignificant a missing item may appear, it is always possible that its omission will affect the operation of the parachute. An incomplete assembly could cause a complete failure.

MANUFACTURER'S ERRORS

If you have ever purchased a new car, you can appreciate the point to be made here. Newness is not necessarily a sign of perfection or even acceptability. Many people are fooled by a bright, new, shining object. Before packing new parachutes for service, make the required inspection of all the assemblies.

FLAWS

Small flaws occasionally found in fabric will not affect the strength or operation of the parachute. The parachute is constructed from the very best grade of materials obtainable which have been subjected to all kinds of tests to prove their superiority. When in doubt about the strength of an item, due to harmful flaws in the material or for any other reason, the best procedure to follow is to turn the parachute in for test and overhaul.

Inspection Intervals

Parachutes are to be given a daily sight inspection, a thorough table inspection at least once every 60 days, and once every 10 days for specific cases in accordance with current directives.

DAILY INSPECTION

All parachutes in service shall be given a daily sight inspection. This inspection, which covers the external appendages of the parachute, can be completed in a short time. This inspection should be made prior to issue and should not interfere with the flight schedule. Any discrepancies of a minor nature must be remedied immediately, while those involving more work should be set aside for dispositioning and overhaul. The following operations are to be performed in making a daily inspection:

1. Check the safety thread on the locking pin. If broken, replace it and find out why it was broken. Check the position of the ripcord pocket and housing.
2. Check the locking cones and grommets for damage and the ripcord pins for bends or breaks.
3. Check the security of the ripcord protector flaps.
4. Check the container for wear and stains. Is the canopy showing? Battery acid is quite often picked up from aircraft bucket seats. These seats should be periodically washed with a neutralizing agent; rinsed with clear water, and dried thoroughly. Watch out for dampness especially after the aircraft have been away from the strip or base for a number of days.
5. Check the pack opening bands for condition and security to the pack.
6. Check the security of the ripcord grip and see that it will come out of the pocket. Check the security of the cable to the grip. A loosely fitting ripcord grip pocket is dangerous.
7. See that the ripcord housing is undamaged and securely fastened.
8. Check the harness for wear, stains, twists, and security of the lift webs where they enter the pack.
9. Check the harness fittings for damage and corrosion. The snaps should work freely but with reasonable tension.
10. Check the back pad and cushion and see that the KEEPERS ARE SECURING these items to the harness.
11. When the oxygen bailout cylinder is used, check the cylinder gage for a full charge (1,800-2,200 p.s.i.). See that the locking pin is removed and the hose line is in good condition.

THE 60-DAY INSPECTION

The 60-day inspection involves a complete check on the parachute. This inspection is most efficiently made prior to packing which is also on a 60-day interval basis. Some prefer to hold the inspection just before hanging the parachutes in the drying locker. Then they are free to pack the next day. Do that which is convenient and SAFE. The 60-day inspection is also given parachutes following a descent.

TROPICAL INSPECTION

In tropical zones, inspection and packing are performed more often due to the higher humidity experienced in this zone. The temperature zones are no exceptions to the 60-day yardstick if, during a rainy season, you believe it necessary to repack more often than every 60 days. Set your own schedule. This holds true aboard ship or ashore. Remember that you enter the tropics at approximately 24 degrees north or south of the Equator.

THE 36-MONTH INSPECTION

Section C0015 (RFI Storage Time Limitations and Processing Codes) of the *Navy Stock List* from the AVIATION SUPPLY OFFICE lists the "shelf life" of "canned" parachutes as being 36 months in storage. After 36 months in storage, the parachutes are shipped to the nearest overhaul station for inspection, drying, and repacking in specially designed metal containers.

Inspection Procedures

INSPECTION TABLE

The inspection table and the packing table are one and the same. Naval air station lofts have little need for the illuminated frosted glass top table. The illuminated inspection table (fig. 3-1) is used mainly by manufacturers and major repair stations where the canopy stitching must be checked to see that it has passed through the required number of folds in the radial and diagonal seams.

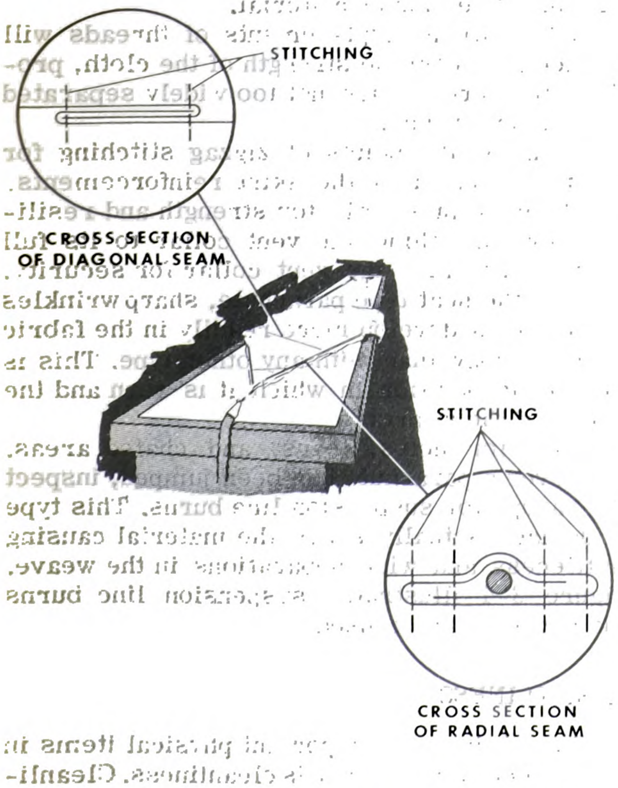


Figure 3-1.—Illuminated inspection table.

Four rows of stitching must pass through the entire length of each radial seam for perfect security and two rows for the diagonal seams. Light directed up through the canopy will show every imperfection in the seam folds and the stitching that missed the seam folds. Every inch of every seam is examined by the manufacturer to insure the security of his product.

First line carriers and seaplane tenders utilize the regular packing table for all kinds of parachute work. Loft facilities aboard CVE's 105 class, CVL's, and AVP's are usually nonexistent. Oftentimes you will have to inspect and pack the parachutes on messhall tables or their equivalent. This condition may require scheduling your inspection and packing between meals, working at night, or waiting for a chance to work on the beach.

INSPECTION OF COMPONENTS

Pilot Chute

A pilot chute is designed to spring out of the pack beyond the negative pressure area created by the free-falling body. To accomplish this, a positive action spring is installed in the canopy of the pilot chute. The two most important factors affecting the successful operation of the pilot chute are the security of the pilot chute to the suspension lines at the peak of the main canopy and the unrestricted action of its spring.

Check the security of the pilot chute to the apex of the main canopy. Are the knots secured tightly in place? Are they the proper type, and is the bitter end of each knot long enough to prevent slippage? Check the length and condition of the connector webbing. Is the connector passed through the peak of the main canopy properly?

Test the action of the pilot chute spring by compressing it and then quickly releasing it. The notes in NAF blueprint 401220 state that the spring is to be completely compressed under a load of 25-30 pounds. Both ends of this spring are held securely in place by swaged fittings. Check all swaged fittings for security by exerting a straight pull of about 10 pounds; if the wire separates or is loose in the fittings, replace the assembly.

Look for stains in the cloth, they can be dangerous and bring about the complete deterioration of the unit. Do not test a stained area for deterioration by stretching the material between the hands or the fingers, as this method can be destructive to perfectly sound cloth. If you suspect acid, check the area with litmus paper moistened with distilled water. You may also GENTLY pick at the spot with a pencil eraser, while observing the material closely.

Acid will completely consume the fibres of the cloth causing them to flake away into a gray ash. Acid is one of the greatest enemies of the parachute.

Look for broken or loose stitching in the seams and hems, keeping in mind the fact that these stitches fasten one unit to the other and represent the parallel use of nuts, bolts, and rivets in machinery.

The pilot chute by virtue of its position in the pack takes a lot of punishment and yet must perform perfectly. Tears, holes, punctures, and chafed areas in the canopy of the pilot chute are caused by wear as the pilot chute is under constant tension and is located uppermost in the pack. The metal spring does not help this condition. Bent or broken springs and frames can cause failure of the unit. The seat type parachute adds to the effect of this situation by its own weight and that of the wearer. A Parachute Rigger should always keep one or two spare pilot chutes on hand for replacement purposes.

Canopy

The main canopy often referred to as "the canopy," "the parachute," "the sail," or a number of other commonly used terms, is the main resistance area of the entire assembly. Canopies have been designed in many shapes and forms, but most of them were designed with these specifications in mind:

1. OPENING TIME: must be quick.
2. STRENGTH: shock of opening must not be too severe for the assembly or the wearer.
3. RATE OF DESCENT FACTOR: the assembly must provide a safe descent under all climatic conditions and at all landing elevations.
4. STABILITY: the oscillations must be kept to a minimum.
5. BULK: must be light in weight; the smaller and thinner the pack, the better.

Starting at the gore bearing the nameplate, the two suspension lines attached to the gores shall be taken, one in either hand, and spread out across the table. This will give you a commanding view from skirt to vent. Continue on around the canopy until all the gores have been checked. Figure 3-2 illustrates this operation.

Look for stained areas in the fabric that may lead to deterioration. Follow the procedure previously outlined for the pilot chute.

Check for broken or loosened stitching in the seams and hems. A pulled seam might indicate a weakened seam. Figure 3-3 illustrates a ruptured section of material.

A few slight displacements of threads will not detract from the strength of the cloth, provided the threads are not too widely separated and are not broken.

Examine the points of zigzag stitching for security, and check the skirt reinforcements. Check the vent elastic for strength and resiliency by stretching the vent collar to its full opening. Examine the vent collar for security.

With the seat type parachute, sharp wrinkles and creases develop more readily in the fabric of the canopy than with any other type. This is due to the position in which it is worn and the weight of the wearer.

Look for holes, tears, and chafed areas. Whenever a parachute has been jumped, inspect the canopy for suspension line burns. This type of damage actually sears the material causing brittleness and wide separations in the weave. Figure 3-4 illustrates suspension line burns and how they are caused.

CLEANLINESS

One of the most important physical items in the inspection procedure is cleanliness. Cleanliness cannot be overemphasized. Before laying

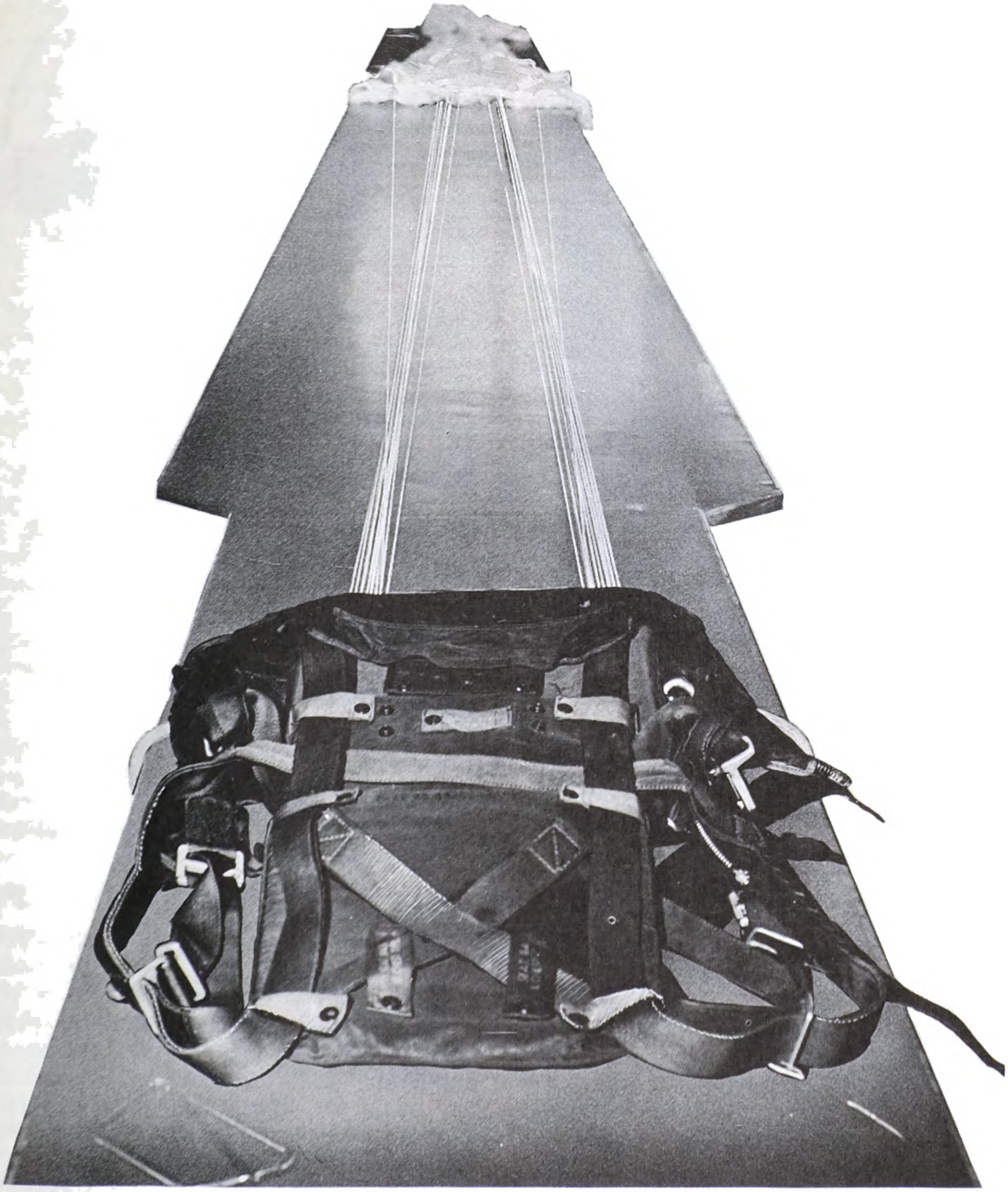


Figure 3-2.—Parachute ready for inspection.

a parachute out on the inspection table, be sure the surface is clean.

Lay the parachute out so that the peak (apex) is toward the head of the table. Engage the links of the lift webs in the holding device. Apply tension by pulling on the peak of the parachute with a length of webbing hooked to the pilot chute connector cord and fasten the webbing to the table. Figure 3-2 illustrates one of the many table methods of placing the parachute under tension for inspection and packing purposes.

Inspect each of the five major parts of the parachute in sequence and all subassemblies

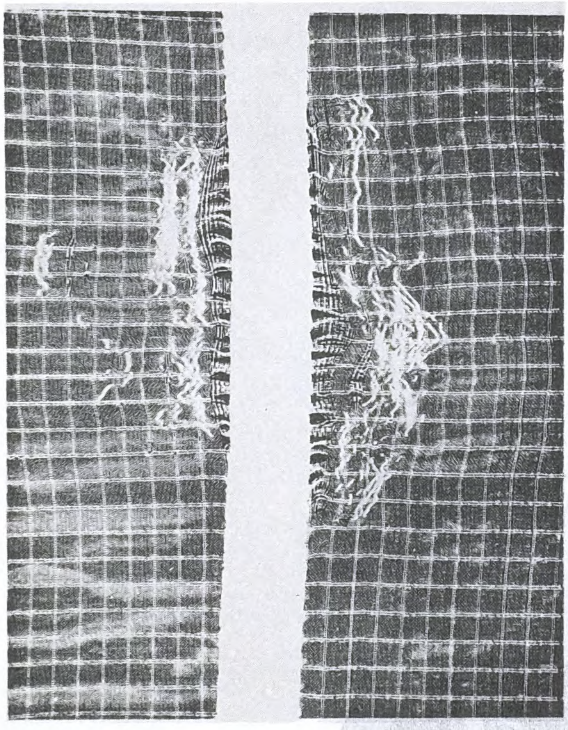


Figure 3-3.—Ruptured parachute cloth.

of each part, beginning with the pilot chute and working down to the pack or container.

A parachute must be thoroughly inspected regardless of its apparent condition. The time required to examine a complete parachute varies with the type and age of the equipment available, but the time devoted is of secondary importance when it is borne in mind that the life of an airman may depend upon close and conscientious work.

To conduct a thorough inspection one must be familiar with all of the technical publications relating to the parachute. Before commencing an inspection, check the striking data stenciled on the canopy of the parachute. If the parachute has reached its strike date, turn it in to Supply and draw another one.

The majority of your work with parachutes and fabrics will be with nylon materials. Learn the material's characteristics. A thorough knowledge of this subject is necessary for you to successfully conduct an inspection. Read the specifications for nylon parachute cloth, webbing, threads and cords, etc. Do not be satisfied with a superficial knowledge of the fabrics you handle day in and day out. You, as a Parachute Rigger, should have a sufficient knowledge of fabrics to conduct an intelligent parachute inspection.

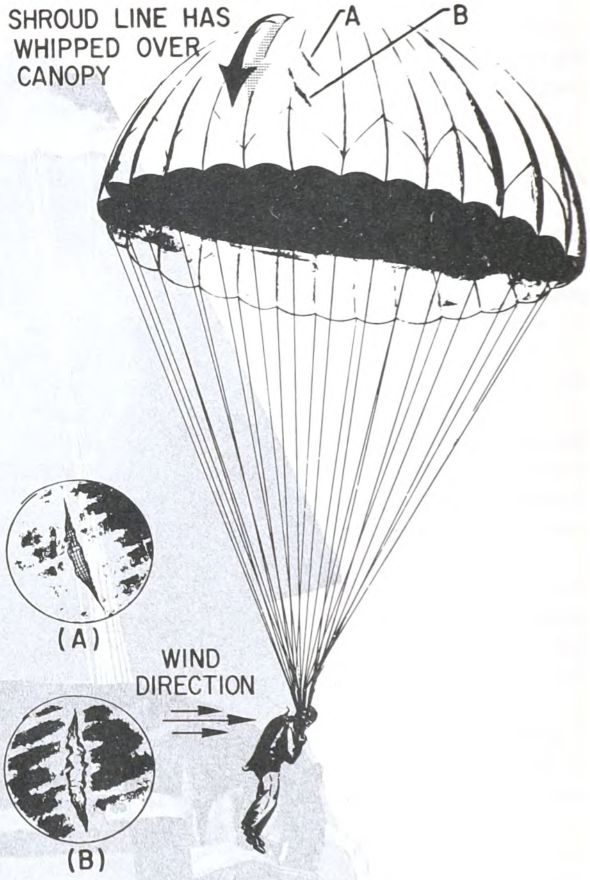

SHROUD LINE HAS WHIPPED OVER CANOPY
A
B
(A)
WIND DIRECTION
(B)

Figure 3-4.—Suspension line burns.

Suspension Lines

Check the suspension line for evidence of fraying and any other sign of weakness. The inevitable stain problem is present here and the inspector should be very careful in his decisions. Suspension lines subjected to the injurious effects of perspiration turn a yellowish or dusty looking color. Check any area suspected of containing acids or alkalies with litmus paper and distilled water, using the method described in chapter 12. In any event, if you are not completely satisfied with the results of the test, take immediate steps to return the parachute for further tests and overhaul to the nearest major repair station.

Superficial snags in the outer covering of the cordage may be disregarded, but when severed inner cords protrude through the weave your only solution is replacement of the line. When snags cause an inner strand to protrude from the weave and form a loop that dangles from the suspension line, use a blunt instrument to push the inner cord back into the line.

Inspect the suspension lines for security to the links and to the canopy. Inspect the removable connector links for the security of the screws holding the link halves together.

The suspension lines of the 28-foot flat type parachute are attached to the removable connector links in four groups with each group containing seven lines.

The lines of the conical 26-foot 22-gore canopy are attached to the removable connector links in four groups as follows: 1 through 5, 6 through 11, 12 through 17, and 18 through 22. Be certain that these lines run continuously, line for line, link for link, all around the periphery of the canopy without any entanglements or crossovers. The conical canopy is constructed differently from the older standard flat type and these differences must be taken into consideration when performing your inspection. Exercise extreme caution when checking the suspension line anchoring points around the shirt of the canopy. The same care must be applied to the anchoring points around the vent as these suspension lines do not run through the canopy from link to link as is the case with the older type canopy. There is no need for a vent collar inspection since the new design does not utilize this feature.

Harness

All webbing straps shall be checked for acid stains, defective stitching, and fraying. Several broken or loose stitches may be replaced provided the original length of stitching is followed with the appropriate thread or cord and the sewing is done with the "right and left" method or with a machine lockstitch. Do not attempt to make other repairs. Send the harness to a major repair station via the Supply Department for disposition.

Look for chafing or shearing at the load points. Recheck the proper attachment of the lift webs to the removable connector links. This is an extremely vital attachment and too much emphasis cannot be placed on the importance of this connection.

Have all the latest modifications been incorporated in the assembly? Are you complying with the current directives? Do you check regularly with your publications officer and make certain that you have not missed anything? You should know everything that is contained in the *Parachute Manual,* NavAer 13-5-501, as this is your basic manual that carries with it the authority needed to guide you in your work.

Check the harness straps for twists. Sometimes these twists are permanently sewed into the assembly erroneously by the manufacturer or major repair activity. The harness is fitted with numerous pieces of hardware. Look for rust and corrosion around these points. Whenever springs are incorporated in the hardware, be sure to check the spring tension by compressing and releasing the "tongue" against which the spring bears. Observe this action. Is it positive and springy, or does it lack the life that was originally built into it? Do not permit rust to remain in contact with nylon or any other fabric. The best policy to follow is cleanliness at any price. Rusty hardware should be replaced by a major repair station. Make sure that the hardware on each harness is of the proper type. Friction hardware should work freely and contain no burrs.

The lift web assemblies of the quick attachable check type parachutes are checked much the same as the procedure outlined for the lift webs of the "fixed type" harness. Make absolutely certain that every quick attachable chest type lift web assembly is fitted with a cross connector strap or yoke. The cross connector strap or yoke joins the snaps into one unit. Figure 3-5 illustrates the importance of a cross connector strap.

The majority of quick attachable harnesses is stowed in aircraft and should not be overlooked at the time the parachute is inspected and packed. Schedule and make regular harness inspections in the aircraft. The harness must be inspected by a qualified Parachute Rigger. Personnel having harnesses in their custody should be required to turn them in periodically for inspection.

Ripcord Grip Pockets

The ripcord grip pocket must be secure and in the proper location on the harness. In the case of the chest type parachute the ripcord grip pocket is located on the pack or container. The elastic should hold the grip firmly but not to the extent of rendering the extraction difficult. Remember that 22 POUNDS is the maximum allowable pull required to release the parachute when testing.

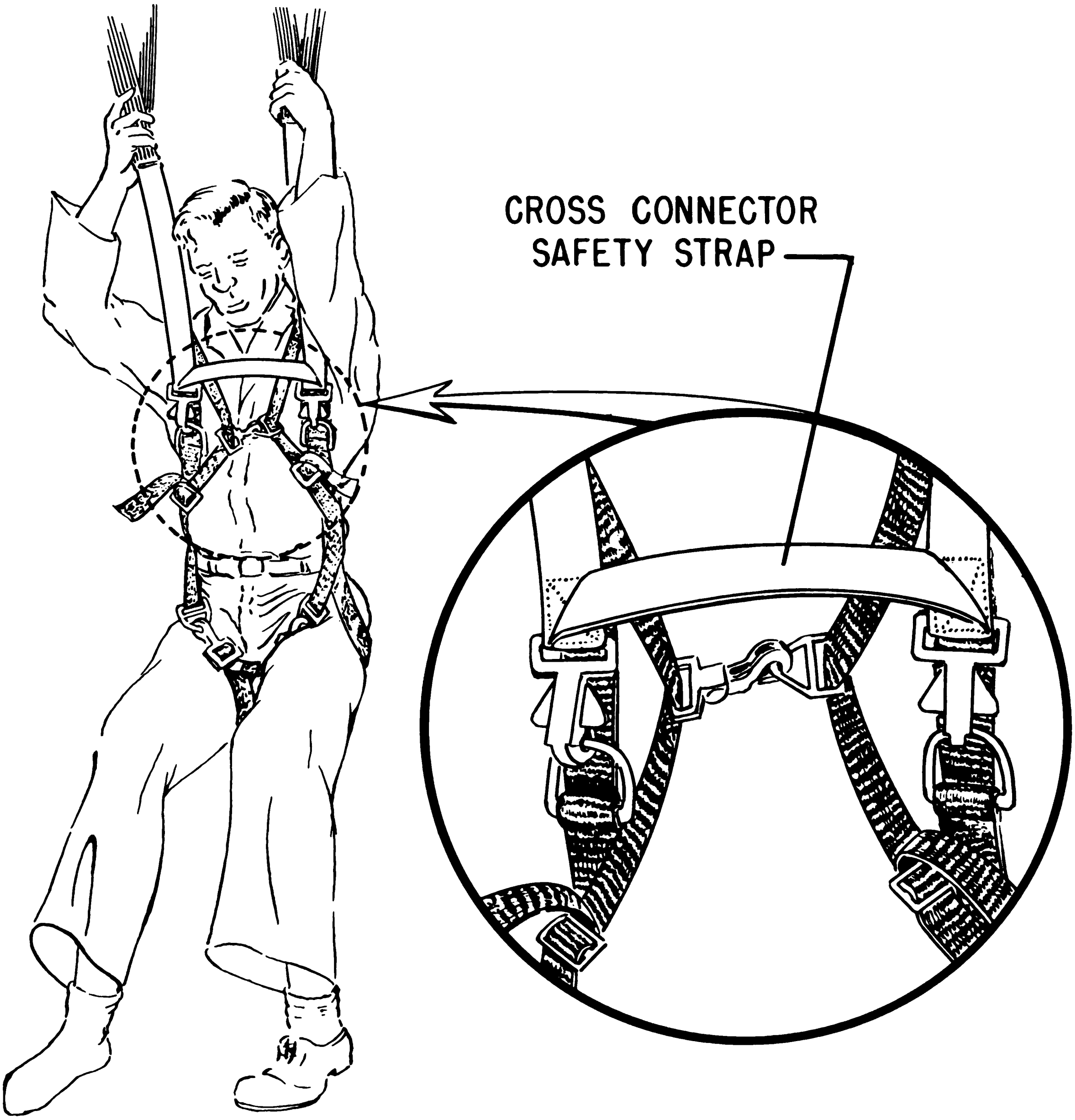


Figure 3-5.—Cross connector safety strap.

Parachute Container

The parachute pack or container is the most abused item of all the assemblies and therefore demands much of your attention. A careful inspection of the pack or container before going into the packing operation will save a lot of work. No sewings or tackings can be made through the pack or container after the parachute has been packed. "Inspect, then pack." Let that be your slogan.

Examine the pack or container for acid stains, holes, and tears. An innocent looking dirt mark can obtain a harmful ingredient that will destroy the fabric. Keep your eyes open for oil marks and smudges that can be picked up from transporting vehicles. Dirty parachute packs or containers and harnesses are an indication of carelessness. Small holes can be darned with the appropriate thread while larger ones require patching.

Check the pack or container for security to the harness, and for the security of one subassembly or unit to the other.

You do not want the pack flying off of the harness when the wearer falls through the slipstream or is ejected through space. The pack is the parachute assembly in a ready service condition. Let's make certain it stays that way: READY. Check the raft case for security. Are all the tackings in their appointed places and are they securely tied? Has the approved cord or thread been used?

Bent pack frames can be straightened safely only after being removed from the pack or container. Pack stiffeners seldom give any trouble. Occasionally one may protrude from its pocket, requiring a little hand or machine stitching to remedy. Examine the pack or container hardware for condition and security. The locking cones and grommets must be perfectly smooth without the slightest trace of a burr which could cause the failure of this unit. A burr is a roughness, usually found on the edge of the cone or grommet. There can be no roughness in the releasing device of a parachute.

Do not tolerate loose fitting or "pulled" pack grommets. A grommet that has pulled loose is detrimental to the operation of the parachute. A "setting method" has been developed whereby the heat generated from punching the grommet hole in the nylon material causes the edge of the hole to sear which helps to prevent the grommet from tearing loose. Pack or container grommets are a special type and cannot be set with ordinary dies. When a grommet associated with the releasing device of the parachute pulls out of its setting, the pack should be renewed.

Check the pack opening bands for spring action, damage, twists, and fouling.

Make sure that everything is sewed in its proper position and is anchored securely. The suspension line loops or hesitator loops are given a great amount of abuse every time a group of lines is drawn through them in packing the parachute. The pilot chute protector flaps, end flaps, corner flaps, and lift web protector flaps are other items on the torture list to be given special attention.

These parts are subjected to strains during packing and require occasional repairs. Check the technical publications and you will find that the parachute pack has undergone more modifications and improvements than any other item.

SECURITY TO THE HARNESS

Check the security of the housing to the harness and pack or container. Replace all loose tackings. Is the passage of the housing correct? Is the housing too low on the harness? If the housing and pocket are located too low on the seat type harness, a stout man will have difficulty in reaching the hand pull with his right hand, especially when the parachute is rigged with the pararaft kit. This is important because the seat type parachute is usually rigged with the pararaft kit.

Ripcords and Housing

Examine the ripcord for bent or burred locking pins, keeping in mind that these pins must be smooth. Check the swagged connections for looseness by exerting a straight pull on the pins with the fingers. Examine the cable for broken strands, kinks, and rust. Rust can sometimes be removed by wiping the cable with a light oil. Rub off all visible traces of the oil after applying it.

Check the ripcord pin spacing with the cone spacing on the corresponding pack or container. The pins should be completely through the cones without bending the cable, as illustrated in figure 3-6.

Inspect the cable for excessive wear at the grip connection. Pull the cable out of the grip as far as it will go to check the "stop" on the extensible type ripcords.

Check the ripcord housing for rust, kinks, breaks, and the condition of the ferrules at each end. The extensible type housing used with the seat type parachute should return to the specified limit, and when released should return to its normal state unimpaired and without aid. This condition cannot be checked with the housing already in a tacked position and there is no need to cut it free to make this inspection as this is only a preinstallation check. The extensible type housing tends to come apart at the joints if mishandled and offers a sharp edge that may foul the ripcord cable.

Seat Cushions and Back Pads

Inspect for security and proper tacking. These items are installed to provide comfort and a perspiration barrier. Watch those back pad keepers; see that they hold the pads where they belong. Keep them clean. Dirt destroys confidence in spite of the fact that the parachute is packed and rigged perfectly. Oftentimes

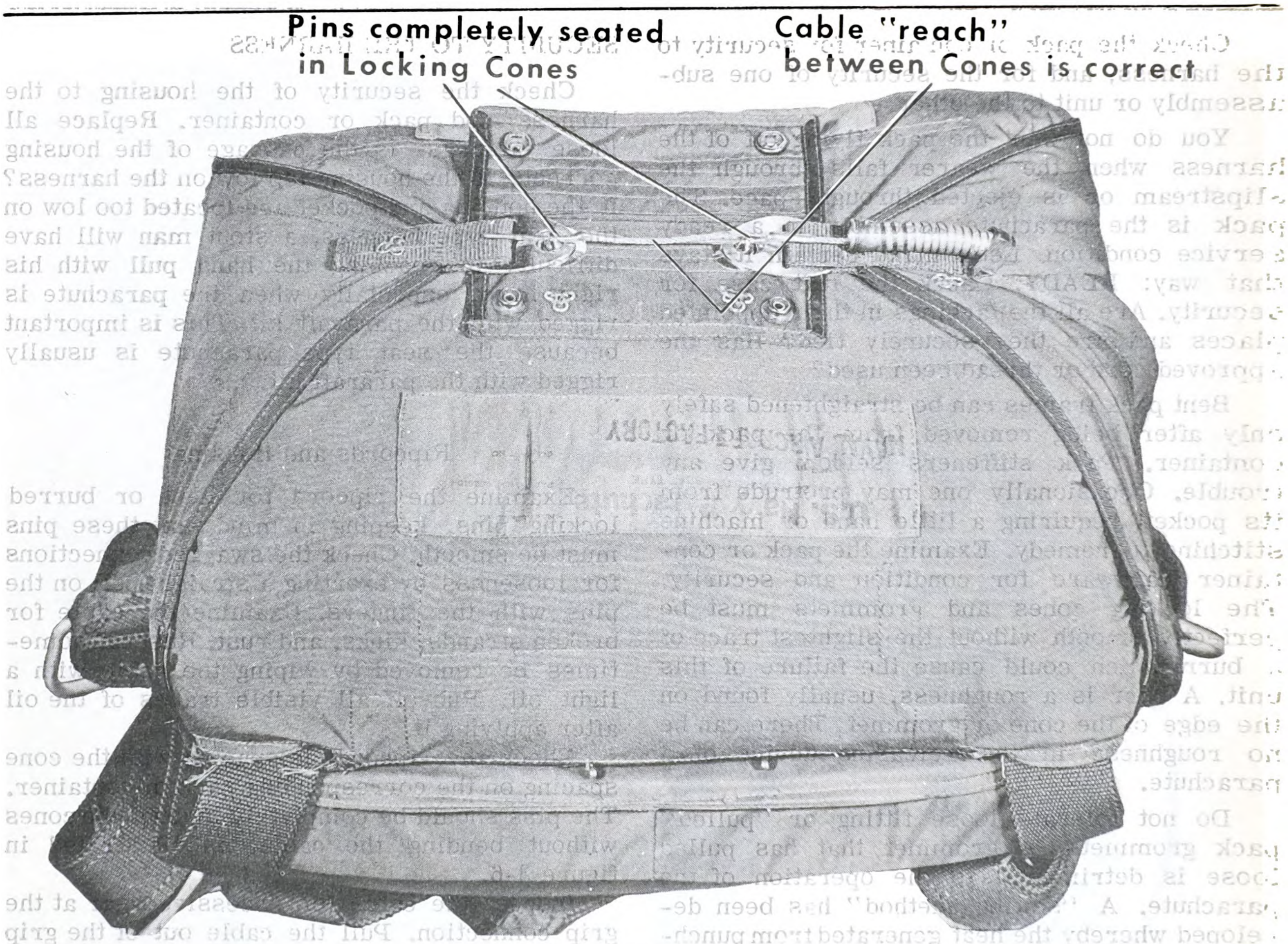

Pins completely seated in Locking Cones
Cable "reach" between Cones is correct

Figure 3-6.—Proper pin spacing.

careless personnel in a squadron use the seat cushions attached to the parachutes as a step in getting in and out of the aircraft. This is a bad practice and should be discouraged.

The seat pan is a seat cushion with an inner aluminum frame shaped like an old iron tractor seat. This frame is topped with sponge rubber and covered with the same material as the seat cushion. The same inspection pattern holds true of this item as for the seat cushion except when it is rigged with the oxygen bailout cylinder. Check the zippered cover which encloses the cylinder for smooth opening action. Look for worn and chafed areas where the cylinder bears against the fabric cover. A reinforcement may be necessary to prevent the cylinder from wearing through. Check the cylinder pressure.

CHECKING TENSILE STRENGTHS

Tensile strength is the greatest longitudinal stress a substance can bear without tearing. Throughout the entire life of a parachute this is the most important characteristic to be safeguarded. All of the materials that are used in the construction of a parachute have been tested and retested in the laboratory to ascertain that their tensile strengths are in accordance with the highest standards of the industry. The nylon cloth, webbings, tapes, and threads are all top quality.

To determine the tensile strength of a strip of cloth or a length of webbing, it is subjected to a break test on a machine. The figure indicated on the measuring instrument is expressed in pounds of breaking strength. For example, the tensile strength of type XIII nylon webbing is 6,000 pounds minimum. The minimum figure signifies that the 6,000-pound strength will not only be reached but will be exceeded by this material. All subsequent samples of this particular soft nylon weave webbing must test at the minimum figure or above in order to be accepted for parachute use. Figure 3-7 illustrates the testing instrument in action.

Every new lot of material received by the parachute manufacturer is tested not only for tensile strength but for other properties as well to make certain that the finished product will meet the rigid specifications of the acceptance tests.

MAINTENANCE AND DISPOSITION OF REPAIRS

The following list is offered as a guide to aid in the dispositioning process. This list shows what defects constitute a major repair which may be carried out only by an authorized repair station equipped for this work. Also, it lists minor repairs which may be carried out by the Parachute Rigger.

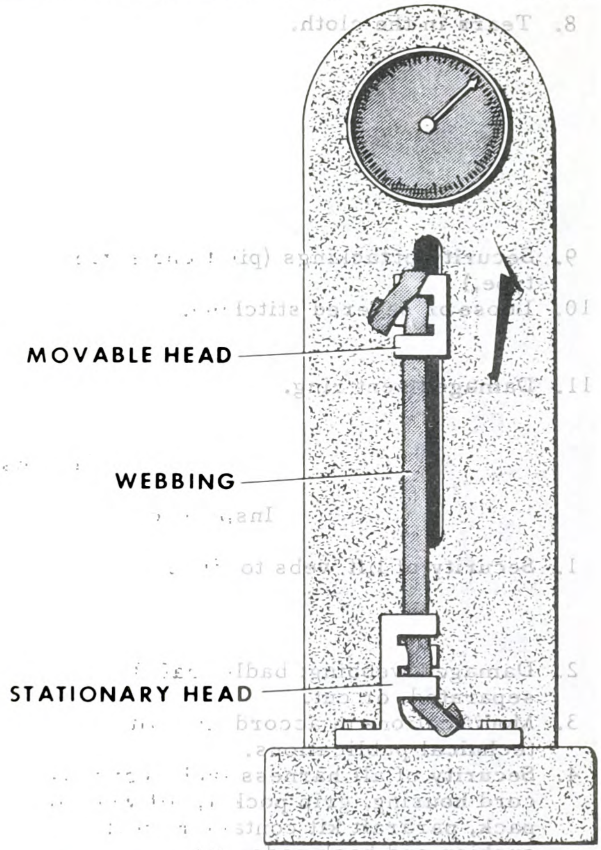


Figure 3-7.—Testing for tensile strength.

Pilot Chute and Main Canopy

Inspect for	Disposition
1. Security of pilot chute to main canopy.	Minor repair; retie or replace webbing.
2. Bent or broken spring.	Minor repair; straighten or replace pilot chute.
3. Loose swaged fittings.	Minor repair; replace pilot chute.
4. Modifications in accordance with technical publications.	Generally involves a minor repair, but occasionally involves a major repair.
5. Damaged suspension lines.	Major repair; replacement of line or group of lines.
6. Suspension lines secured out of rotation on the removable links.	Minor repair; slip lines off removable link and replace in proper sequence.
7. Stains.	Minor or major repair, depending on the origin and size of area or areas. For minor repair, test for a caustic substance in the affected area and in adjoining areas. After a negative test, wash and dry, then retest. Advanced small caustic stained areas may be cut out, treated as a tear and patched. Areas indicating a caustic element but not suffering any apparent damage may be neutralized, washed, and dried. Retest. A "canopy change" is classified as a minor repair so long as no sewing is involved in the operation. Large or numerous small caustic stained areas require a major repair classification.

8. Tears in the cloth.	Minor repair with limatations.-Tears 8 inches or under not crossing radial seams, diagonal seams, skirt, or vent hems. Only two single or one double patch per panel, and when it becomes necessary to exceed this, the repair is classified as major. Major repair.-Tears or holes greater than 8 inches. Any size tear across seams or the vent and skirt hems.
9. Security of tackings (pilot chute vane type.)	Minor repair; retack.
10. Loose or severed stitching.	Minor repair; brush loose stitching back into cloth. Short lengths of damaged stitching may be resewed.
11. Damaged vent ring.	Minor repair; replace.

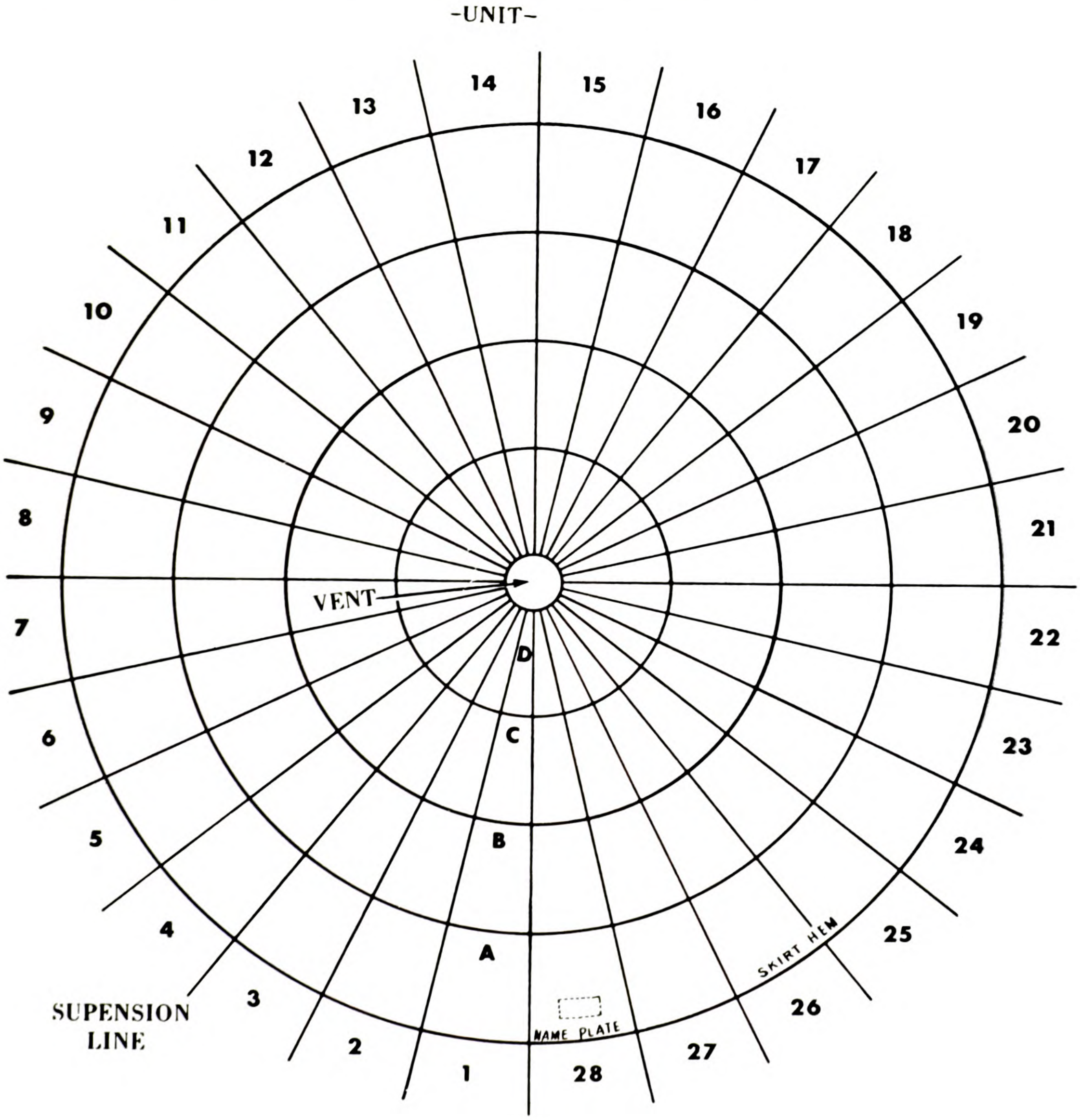
Harness and Pack

Inspect for	Disposition
1. Security of lift webs to links.	Major repair; if lift web attachment sewing is involved. Minor repair; tighten removable connector link screws to proper torque.
2. Damaged webbing: badly chafed, separated, or cut.	Minor repairs; harness replacement involving no sewing; salvage hardware.
3. Modifications in accordance with technical publications.	Generally involves a minor repair, but occasionally involves a major repair.
4. Security of all harness tackings; ripcord housing, grip pocket, lift webs to pack, pararaft kit container, seat cushion and back pads, etc.	Minor repair; retack where necessary.
5. Loose or severed harness stitching.	Major repair; if more than several stitches replace harness. (Replacing harness is a minor repair when lift web sewing is not involved.)
6. Stained and dirty harness.	Minor repair; test for caustics, if present, remove harness, neutralize, wash, dry, and retest. If any doubt of the tensile strength exists, return harness to major repair stations for test.
7. Improper location and operation of hardware. Permanent twists in chest and back straps.	Major repair; return harness to major repair station for overhaul.
8. Security of pack to harness.	Minor repair; machine sew keepers, retack. All pack changes are classified as a minor repair.
9. Damaged ripcord, housing, grip pocket, back pads, and seat cushions.	Minor repair; Replace and salvage damaged parts.

Figure 3-8 illustrates a 28-foot canopy chart and inspection report form used by activities servicing parachutes.

Any time a parachute is forwarded to a major repair station for examination or repair, the completed canopy chart, an inspection report form, and the Parachute History Card (NavAer 2771), must accompany the parachute in its shipment. This information will expedite the return of parachutes to active service by permitting immediate attention to those parachutes most readily repairable.

The parachute inspection form recommended by the *Parachute Manual*, NavAer 13-5-501, may be prepared locally for use of activities servicing parachutes. Use of the inspection form and canopy chart discourages the prohibited practice of personnel making marks directly on the parachute when a defective area is noted. A copy of the inspection form is shown on page 50.



SERIAL NO: ____________ DATE: ____________

TYPE ____________ INSPECTOR ____________

RED-RUPTURES BLUE-CORDAGE BURNS GREEN-SEAM SEPARATION

REMARKS: ____________

Figure 3-8.—Canopy chart.

INSPECTION REPORT

Date ____________

Parachute No. ____________ Inspector ______________________________

PART	O.K.	REATTACH	REPAIR	REPLACE	REMARKS	CHANGES (Authorized by)
A. HARNESS:						
Hand Grip Pocket						
Ripcord Housing						
Releasing Device						
Webbing and Attachment						
Metal Fittings						
Back Cushion						
Modifications						
B. PACK:						
Cushion						
Suspension Line Loops						
Flaps and Tabs						
Stiffeners						
Pockets						
Grommets						
Cones						
Hooks and Eyes						
Elastics						
Frame						
Modifications						
C. SUSPENSION LINES:						
Zigzag Stitching						
Suspension Lines						
Links to Skirt						
D. CANOPY:						
Fabric						
Skirt						
Radial Seams						
Zigzag Stitching						
Diagonal Seams						
Vent Collar						
Vent Ring						
E. PILOT CHUTE:						
Pilot Chute Tie						
Cord						
Fabric						
Rib Pockets						
Wire Frame						
Suspension Lines						

Transfer

Parachutes not requiring repair CANNOT be transferred from the unit to which they have been assigned without authority from your aviation supply officer. ALL transportation involving shipment of parachutes to major repair stations shall be by government conveyance.

Survey

The service life of the parachute is 7 years from the date of manufacture, and the parachute is withdrawn at the end of the month that is stamped on the canopy. Parachutes cannot be surveyed by aviation units unless lost or completely destroyed. Parachutes found unsuitable for use prior to the expiration of service life and those that have reached the striking date shall be turned in to the nearest supply activity for forwarding by the Aviation Supply Officer to the Naval Air Station, Alameda, California, or the Naval Aircraft Factory, Philadelphia, Pennsylvania, whichever is nearer, for disposition.

QUIZ

1. A white crystalline substance on a parachute canopy would be an indication of
   a. acid stain
   b. salt water stain
   c. naphthalene
   d. static electricity

2. Stains on a parachute canopy should be removed because they
   a. make the fabric brittle
   b. ruin the appearance
   c. make the parachute hard to pack
   d. tend to deteriorate the fabric

3. If for any reason there is doubt as to the strength of the canopy or the suspension lines on a parachute, the best procedure to follow is
   a. drop test the parachute
   b. keep it in the loft, but issue it only when necessary
   c. turn the parachute in for test and overhaul
   d. survey the parachute

4. Parachutes in service are given a visual inspection
   a. daily
   b. weekly
   c. every 10 days
   d. every 60 days

5. Parachutes in service will be given a complete inspection every
   a. 10 days
   b. 30 days
   c. 60 days
   d. 90 days

6. In tropical regions parachutes are repacked more often than in temperate regions because of
   a. high temperatures
   b. high humidity
   c. low temperatures
   d. low humidity

7. The shelf life of parachutes, stored in sealed metal containers, will not exceed
   a. 1 year
   b. 3 years
   c. 5 years
   d. 7 years

8. Radial seams are constructed of
   a. 1 row of stitches
   b. 2 rows of stitches
   c. 3 rows of stitches
   d. 4 rows of stitches

9. The pilot chute spring should be completely compressed under a load of
   a. 15 to 20 pounds
   b. 20 to 25 pounds
   c. 25 to 30 pounds
   d. 30 to 35 pounds

10. If the swaged fittings on the pilot chute are loose, you should
    a. press with pliers until tight
    b. solder the joint
    c. return the parachute to Supply
    d. replace the assembly

11. Sharp wrinkles and creases are most likely to develop in the
    a. NC-3
    b. NS-3
    c. NB-3
    d. NB-7

12. When a suspension line is found to have an inner cord protruding through the weave, you should
    a. push it back in place with a blunt instrument
    b. replace the line
    c. turn the parachute in for overhaul
    d. disregard it

13. A conical canopy is composed of
    a. 22 gores
    b. 26 gores
    c. 28 gores
    d. no gores, it is made in one piece

14. The Parachute Manual is identified by the number
    a. NavAer 2743
    b. MIL-F-6903
    c. NavAer 13-5-501
    d. NavAer 01-13-5

15. To withdraw the ripcord from a parachute, the maximum allowable pull is
    a. 12 pounds
    b. 20 pounds
    c. 22 pounds
    d. 26 pounds

16. The most abused item of the parachute assembly is the
    a. pilot chute
    b. canopy
    c. harness
    d. container

17. Rust can be removed from the ripcord cable by
    a. washing in Stoddard solvent
    b. wiping with light oil
    c. sanding with a fine grade sandpaper
    d. carefully filing with a jeweler's file

18. The extensible type ripcord housing is used with the
    a. NC-3 parachute
    b. NB-5 parachute
    c. NB-8 parachute
    d. NS-3 parachute

19. The most important characteristic of parachute material is
    a. durability
    b. elasticity
    c. bias construction
    d. tensile strength

20. The nylon webbing which has a tensile strength of 6,000 pounds is
    a. type VIII
    b. type X
    c. type XII
    d. type XIII

21. On a 28-foot, flat type canopy the nameplate is on gore number
    a. 1
    b. 14
    c. 28
    d. 14 and 28

22. Parachutes which do not require major repairs cannot be transferred from one unit to another without approval of the
    a. Shop Chief
    b. Maintenance Officer
    c. Aviation Supply Officer
    d. Commanding Officer

23. The service life of a parachute is
    a. 7 years from date of manufacture
    b. 7 years from date of issue
    c. 7 years from date it is placed in service
    d. undetermined; may be used until found to be unfit for service

24. Parachutes are surveyed by aviation units
    a. whenever they are found to be unfit for service
    b. only after the expiration of service life
    c. whenever they require major repairs
    d. only when lost or completely destroyed

25. A 5-inch tear across the radial seam on a parachute canopy would require
    a. a single outside patch
    b. a double patch (one inside and one outside)
    c. a major repair
    d. surveying the parachute

CHAPTER 4

PARACHUTE PACKING AND RIGGING

Packing is more than a matter of inserting a canopy into its pack. Parachute packing is a system. It is a combination of inspecting, packing, and rigging. However, most of the inspection phases of the operation can be carried out independently. Thus, inspection was treated separately in the previous chapter. The perfect working of the parachute depends on the methods used in the packing and rigging processes. Packing is essentially the same for all parachutes, although the external rigging will differ considerably. If a thorough and reliable packing procedure is understood, a Rigger will be able to apply that knowledge to any type of parachute and will be able to pack a parachute in a short period of time.

The beginner may take as long as 45 minutes to pack a parachute. A larger part of that time will be spent on the stowage of suspension lines. After a few weeks practice, this time will shorten to an average of 20 minutes or less until peak performance is reached. Due to the uniform system taught to Navy Riggers, any two men can soon work in harmony and form a good packing team. Remember, speed is secondary to accuracy. Recognize your best packing speed and settle down to a good reliable pace that guarantees perfection.

RIGGING TOOLS

Sewing Needles

Sail needles are too large and bulky for use as a regular tailor's needle, but are necessary when working with heavy material. Most tackings on the parachute are accomplished with a sail needle and sewing palm. Some prefer a pair of smooth jawed pliers to the palm for pushing the needle through tough material. The general rule to follow in selecting the proper needle size corresponding to the cord size is: THE CORD SHOULD PASS FREELY THROUGH THE EYE OF THE NEEDLE. Difficulty is encountered in passing a needle through a piece of cloth when the needle is threaded with a cord too heavy for the eye. (See fig. 4-1.)

The eye of the needle is intended to offer just enough resistance to the thread or cord so that the needle will hold its place and not slide out of position. An improper selection will interfere with speed and efficiency and will increase the possibility of damaging the material. Numbers 14 and 16 are the most popular sail needles used in parachute work.

There are three common types of needles used for general hand sewing:

1. Sharps: standard length, small round eye.
2. Betweens: short length, small round eye.
3. Crewel: standard length, narrow eye; large size for yarn work.

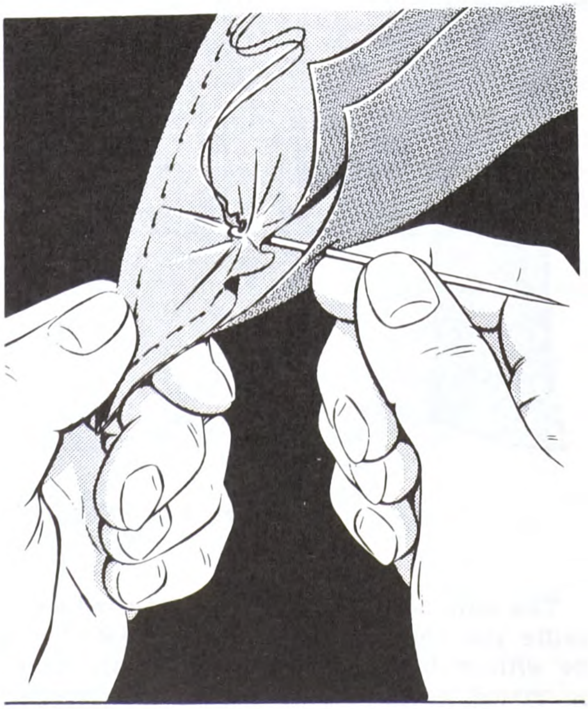


Figure 4-1.—Needle fails to make large enough hole for the cord.

The choice of a type of needle depends upon the kind of sewing to be done. Needles are issued by number. The ordinary hand sewing needle ranges in size from 1 to 12. The higher the number, the finer the needle.

Good grade needles are issued in a specially treated black paper package. When needles are not in use, they should be replaced in this specially treated package as it prevents rusting. (See fig. 4-2.)

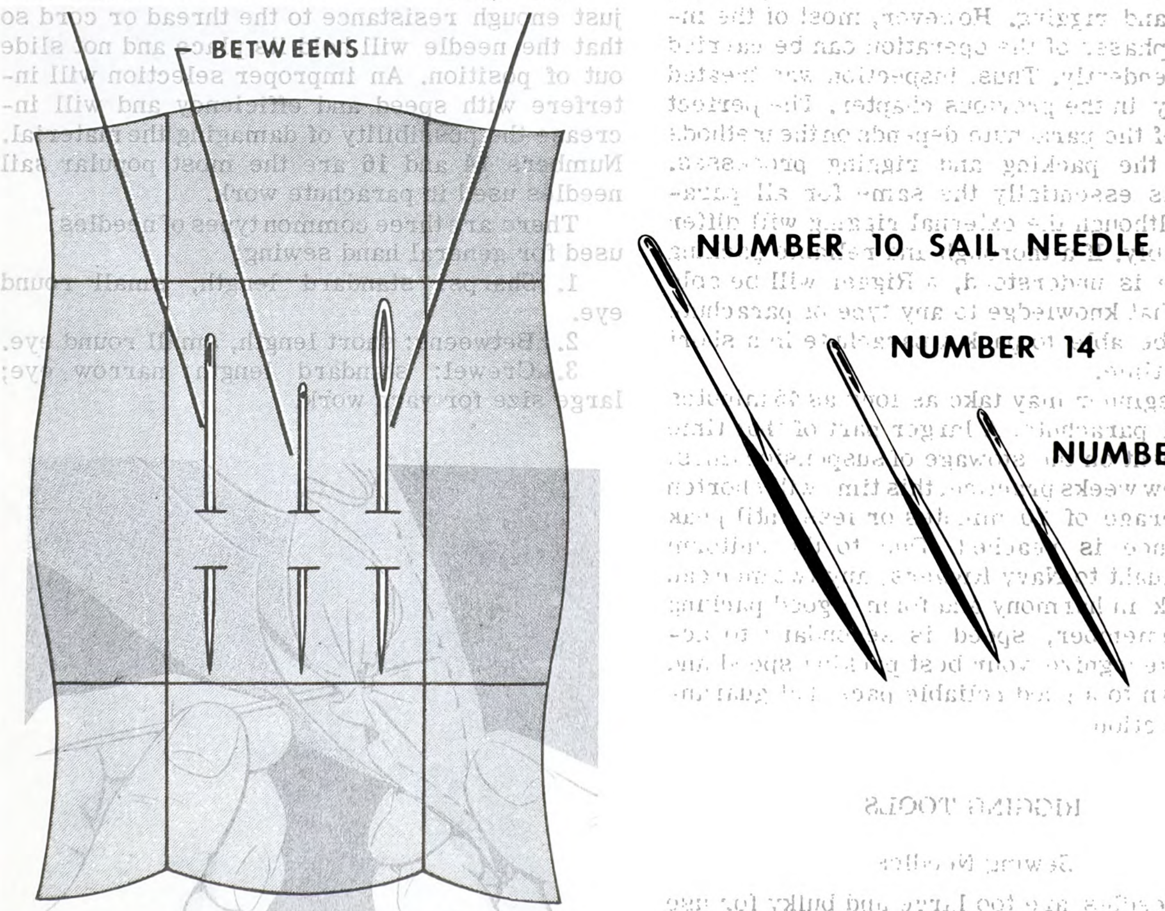


Figure 4-2.—Needles used for general hand sewing.

The sail needle is the toughest hand sewing needle you can find. It will take a lot of rough use without breaking at the eye as will many of the round needles. The distinctive feature of the sail needle is its broad, three-edged shape in relation to its size. This sometimes prevents its use in hard, closely woven cloth. Loosely woven fabrics are most adaptable to sail needlework. There are a few carpet type needles adaptable to tacking threads and cords, but they lack the necessary strength in the eye. To make a tacking requires a lot of push and sometimes pull. No one's finger is tough enough to do the job. That is when a palm or a pair of smooth jawed pliers come in handy. When applying the force necessary to drive the needle through, be careful not to apply a side thrust as this may break the needle. Always apply a straight, steady push or pull, taking care not to mar or scratch the needle. The careful use of smooth jawed pliers is emphasized, as they will not scratch as easily as a pair of rough jawed pliers. Keep needles smooth and the points sharp by frequent use of a sharpening stone.

Hand Tools

T[illegible]nd tools contained in the standard tool [illegible]e sufficient for packing the standard ches[illegible], and back type parachutes. Additional item[illegible]nsisting of a shot bag (A), cord (B), and [illegible]d (C), pliers (D), scissors (E), and closi[illegible]ords (F), are required for packing and r[illegible]ng. (See fig. 4-3.)

Packing Tools

The Parachute Rigger's packing tool kit (fig. 4-4) reveals a simple array of tools. The individual tools, while unimpressive in appearance, are quite specialized in application. The individual tools cannot be drawn from stock; they are issued only in the complete kit.

During earlier days when parachute rigging was extracurricular, Riggers made their own tools, usually while in school learning to pack and rig parachutes. In the early 1940's the first manufactured tool kits were purchased by the Navy. These tool kits were issued by the Parachute Rigger School to its students upon graduation. Later, these kits were made available through various Navy supply points. The kit, as issued, is intended for packing purposes only. Tools contained in the standard kit are shown in figures 4-5 through 4-10.

SUSPENSION LINE ENTANGLEMENTS

Entanglements are caused by the canopy or harness passing in between the suspension lines. In chapter 2 we studied the method of attaching the suspension lines to the links and in turn how the links are attached to the lift webs of the harness (lift web assembly of a chest type parachute).

A canopy or harness, with pack attached, may pass between any number of the suspension lines and from any angle. The simplest entanglement occurs when the canopy or harness passes directly forward or backward between the two major dividing groups of lines. The dividing groups (suspension lines) on a 28-foot parachute (wearer in harness, canopy nameplate forward) are numbered from 1 to 14; all the lines of this group are connected to the links of the two right lift webs. Suspension lines numbered from 15 to 28 are connected to the links of the two left lift webs. Figure 4-11 illustrates this simplest type of entanglement.

When the canopy and harness pass between the lines while the lines are twisted, or pass through from a sharp angle, a different type of entanglement results. This type of entanglement is not as orderly as the type first described. The second type can result from any number of entangling conditions; but regardless of how

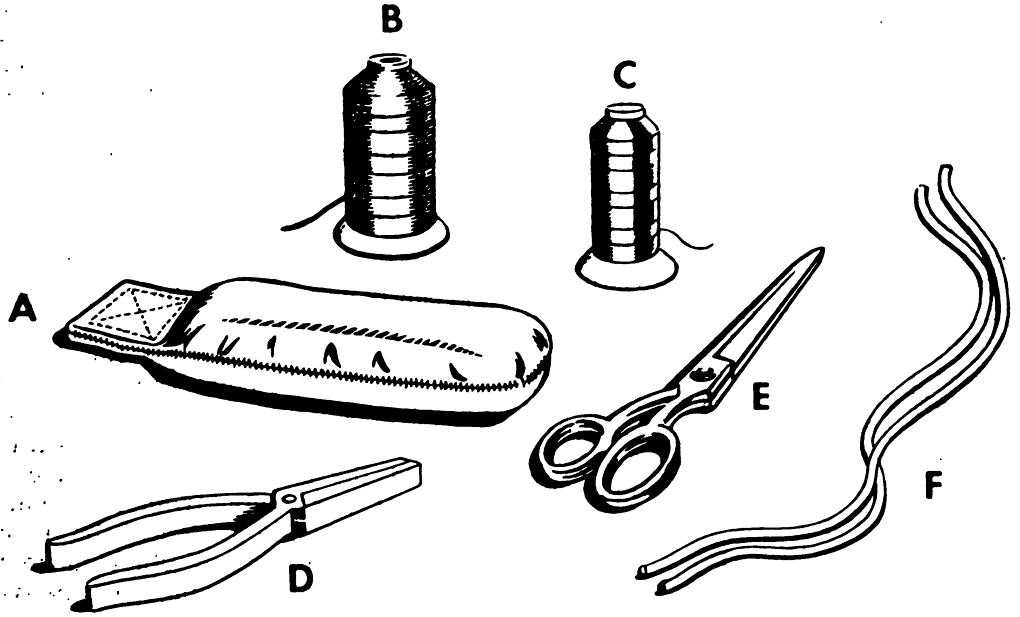


Figure 4-3.—Shot bag, cord and thread, pliers, scissors, and closing cords.

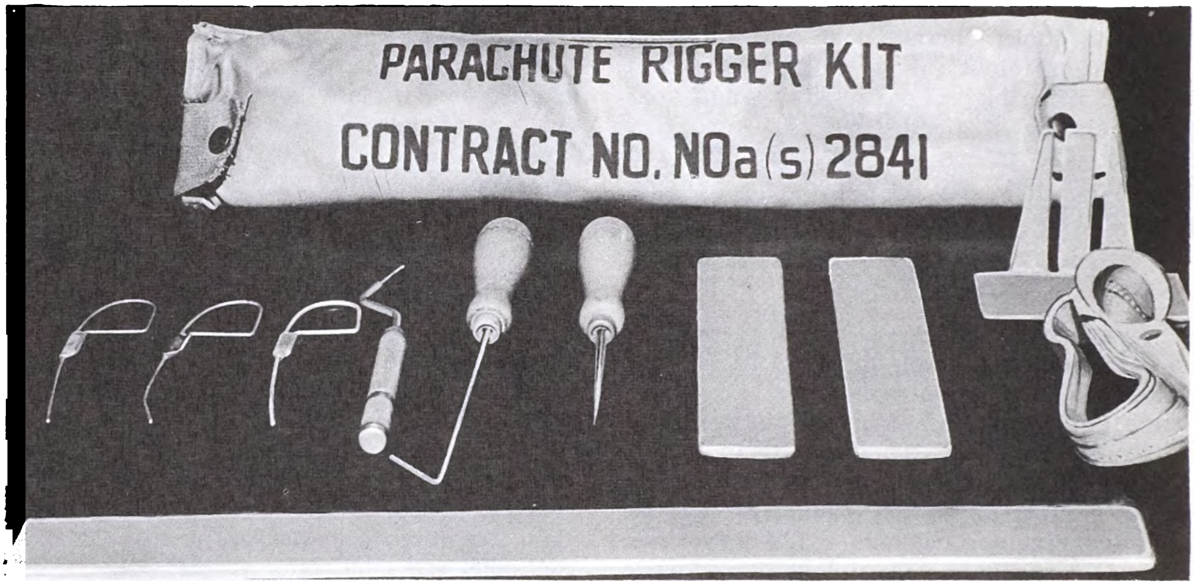


Figure 4-4.—Parachute Rigger's packing tool kit.

badly the suspension lines become entangled, this second type of entanglement is easily recognized and just as easily removed. Figure 4-12 illustrates the simplest combination of this type of entanglement.

Removing Suspension Line Entanglements

The first consideration in the methods employed to disentangle a fouled parachute is to do it without damage to the suspension lines and canopy. The RIGHT AND LEFT METHOD is the best for removing fouls in a parachute.

This system of removal gets its name from the fact that entanglements are removed by passing the fouled lines around the pack either to the right or left, as the fouls indicate. The chest type parachute harness is removed during the untangling process. Such is not the case with the other service parachutes where it is necessary to closely secure the harness to the pack in order to keep the harness from fouling in the lines as they are passed around the pack. Before proceeding to remove entanglements, always untie any knotted portions from the suspension lines.

THE RIGHT METHOD

When a single suspension line from the two right groups of lines is entangled in the two left groups (looking toward the canopy), proceed to remove the foul as follows:

Grasp the suspension line belonging on the right side at the point where it crosses over the left group and branches off to the canopy, as shown in figure 4-13. Pass this line around and behind the pack and harness, depending on the type of parachute, from the left to the right. In fact, the fouled line could not be returned to its group in any other way. Passing the lines around the canopy is NOT recommended.

In order to follow these recommendations for removing fouls, it would be advisable for the beginner to lay out a parachute and practice these procedures step by step.

THE LEFT METHOD

When a single suspension line from the left group is entangled in the right group, proceed to remove the foul as follows:

Grasp the suspension line belonging on the left side at the point where it crosses over the right group and branches off to the canopy, as shown in figure 4-14. Pass this line around and behind the pack or harness, depending on the type of parachute, from the right to the left. The fouled line CANNOT be returned to its proper group in any other more logical way.

Instead of removing one line from the right group which is entangled in the left, try removing two, three, etc., until any number of "rights and lefts" can be removed. It takes practice to sight and remove entanglements quickly.

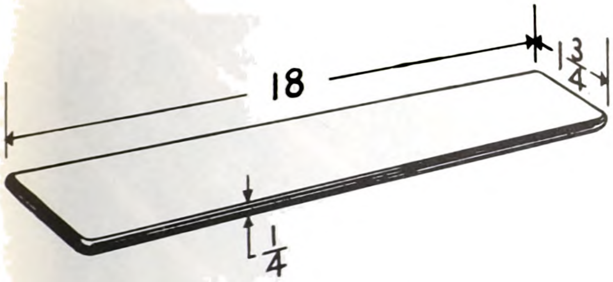


Figure 4-5.—Long bar.

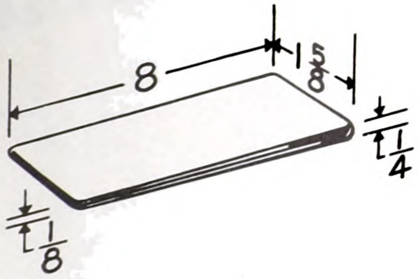


Figure 4-6.—Fid.

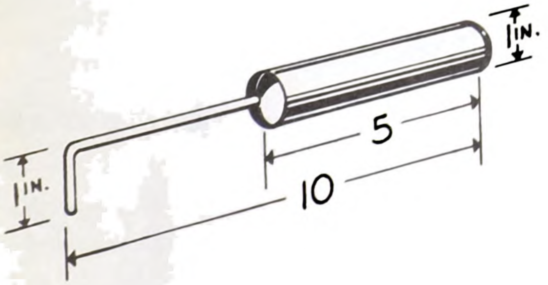


Figure 4-7.—Suspension line hook.

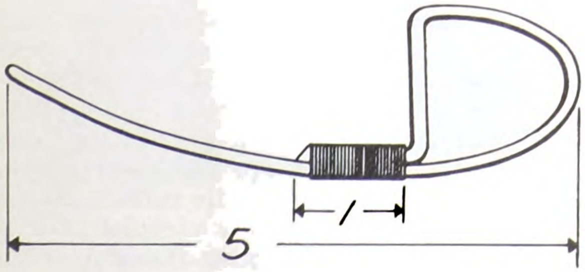


Figure 4-8.—Temporary locking pin.

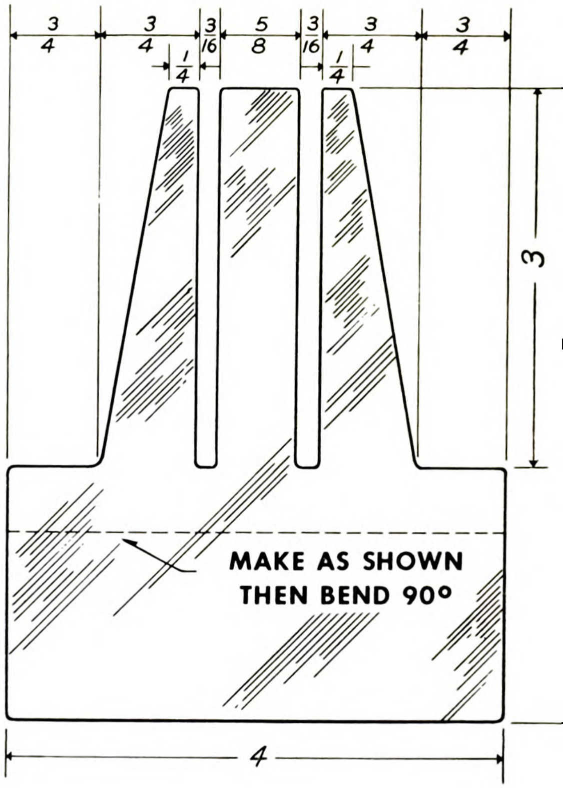


Figure 4-9.—Suspension line holder.

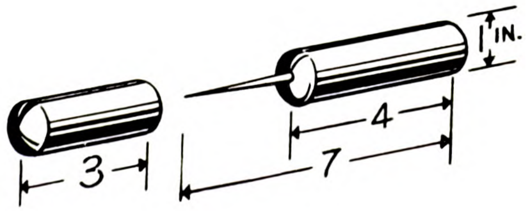


Figure 4-10.—Awl.

Set up any series of entanglements. will soon learn to follow a few simple r namely:

1. If the lines are knotted, the knots be removed first.

2. The "rights and lefts' must be rem before any of the simplest entanglements scribed earlier and illustrated in figure can be removed.

3. Attack one group at a time. First and then a right. Work from the pack, gras the fouled line or lines closest to the Any number of lines can be passed at the time provided they are all situated togethe

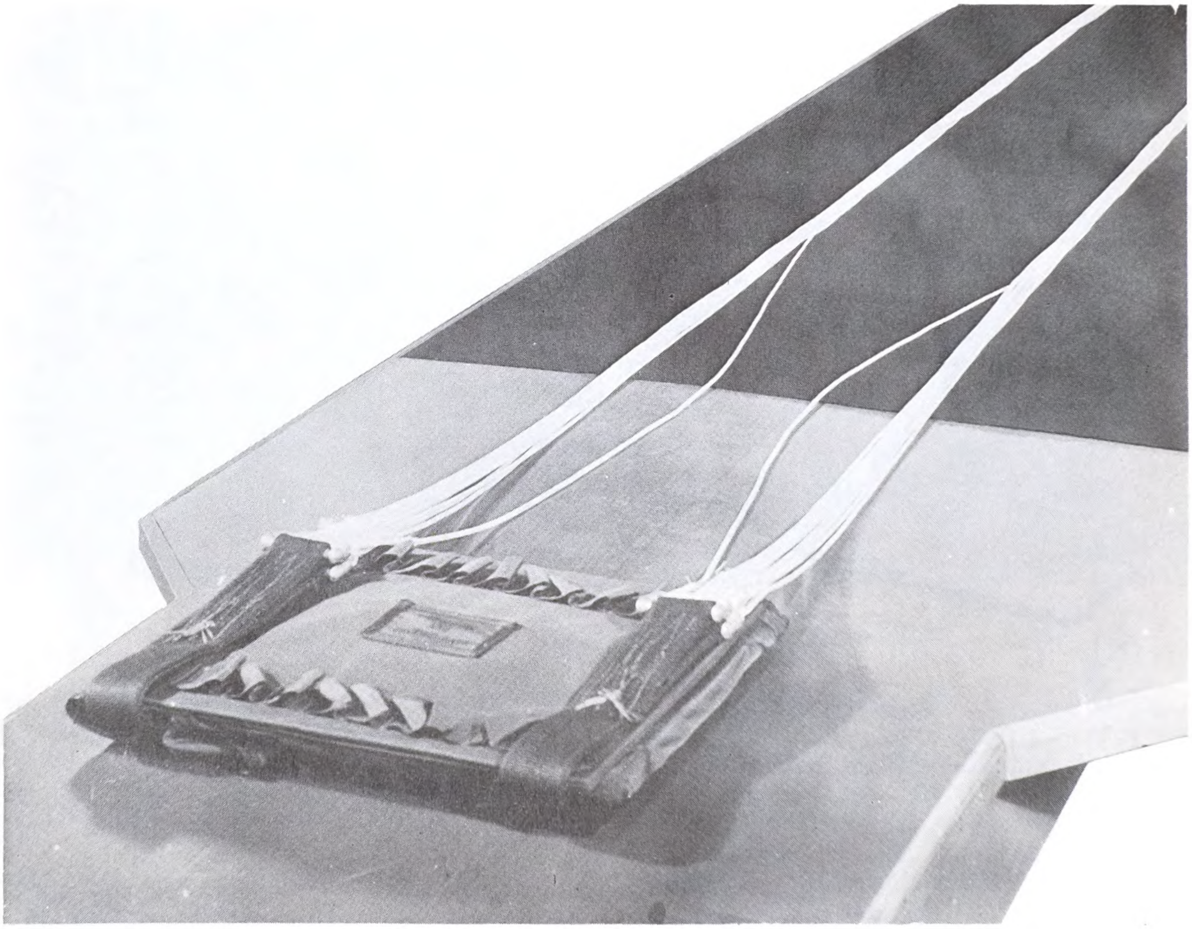


Figure 4-11.—Entanglement resulting from the canopy or harness passing directly between the dividing groups of lines.

4. Check the suspension lines for clearance to the top gore of the canopy containing the nameplate. The nameplate must be readable from the outside of the gore, if the canopy is not inside out.

5. Once the lines are cleared completely, check the rotation of the lines around the canopy as described in chapter 3.

Figure 4-15 illustrates the method of removing the entanglements caused by the canopy or harness after they have passed directly between the dividing groups of lines.

Remove the simplest entanglements last by turning the harness and pack between the dividing right and left groups in the opposite direction from which they were made. There may be any number of fouls caused by the forward or backward somersaults of the harness or canopy. Four forward fouls will require four backward turns to remove them, and vice versa.

Figure 4-16 illustrates the two top inboard lines clear and running free from the links to the canopy.

DRYING PARACHUTES

Before a parachute can be packed, a drying period is essential. Drying a parachute under controlled temperature and humidity is necessary for positive functioning and long serviceable life. A parachute must undergo a 24-hour drying period during which time the fabric of the canopy is given a chance to air out. The sharp creases and folds set in the cloth while packed literally disappear as a result of the circulation of air and the weight of the hanging assembly. Nylon fabric is hygroscopic; that is, it gives off and takes on moisture from the surrounding atmosphere.

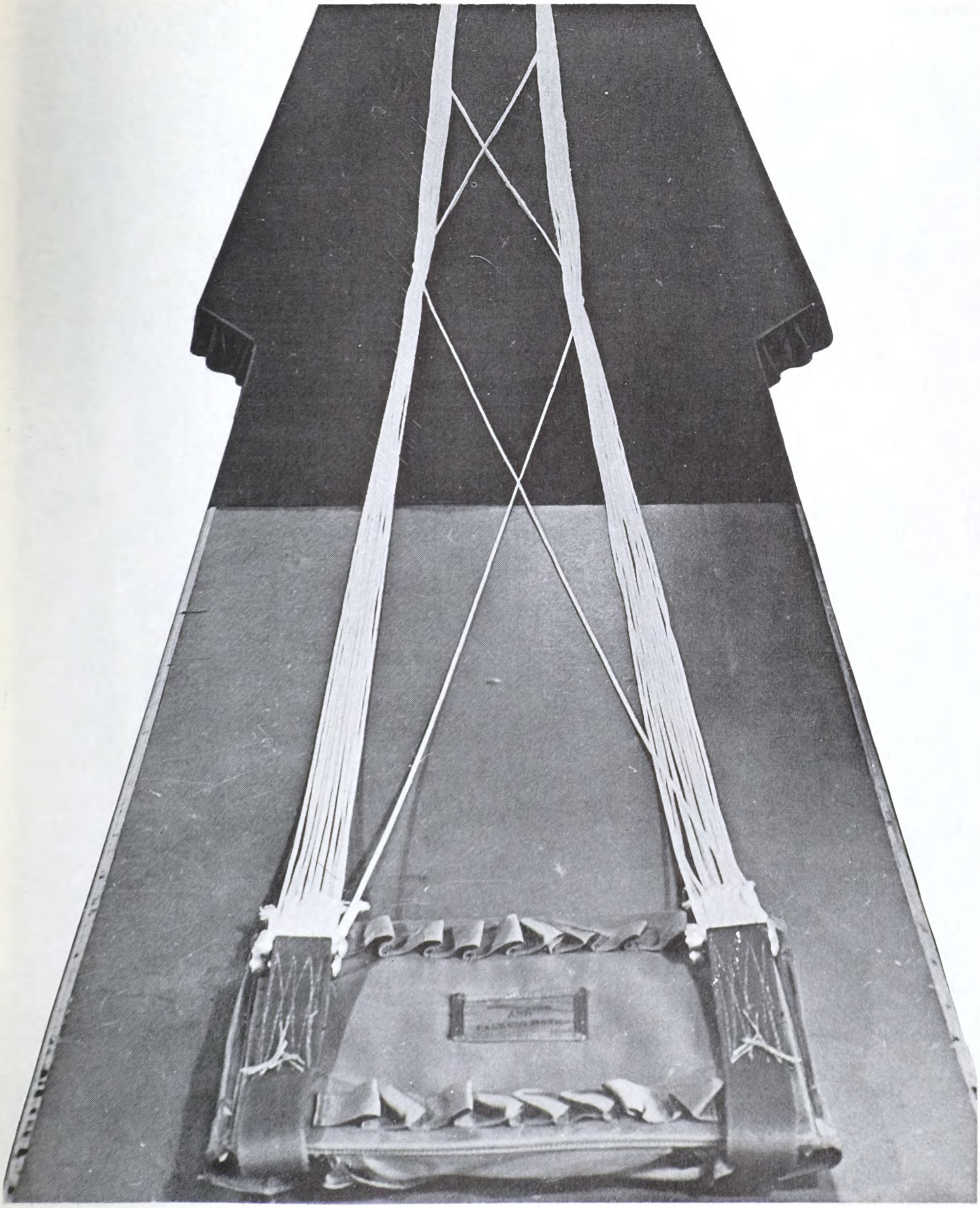


Figure 4-12.—Right and left groups of suspension lines entangled. One suspension line from the left group is entangled in the right group, and one suspension line from the right group is entangled in the left group.

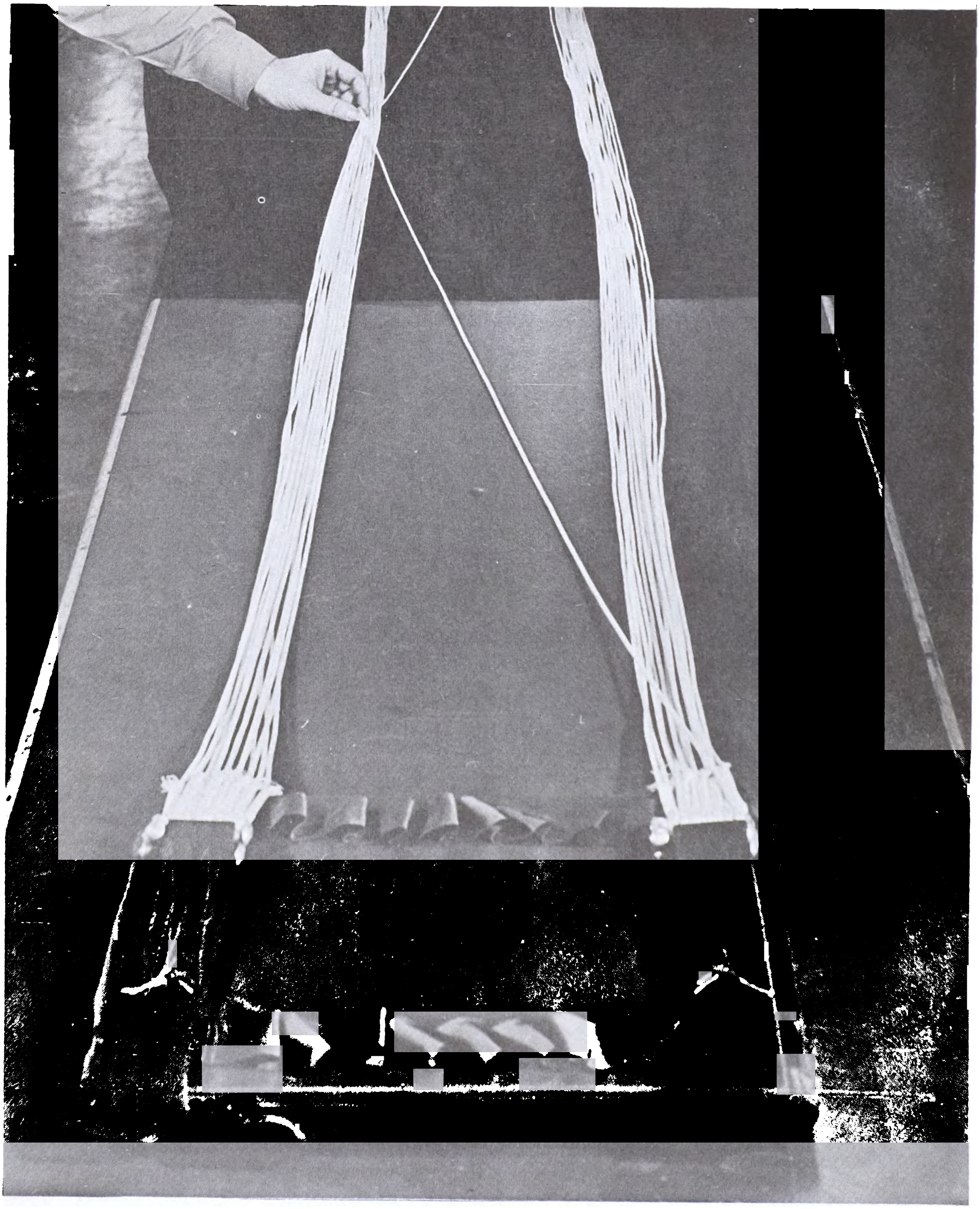


Figure 4-13.—Grasp fouled line where it crosses over the left group and prepare to return it to its own group.

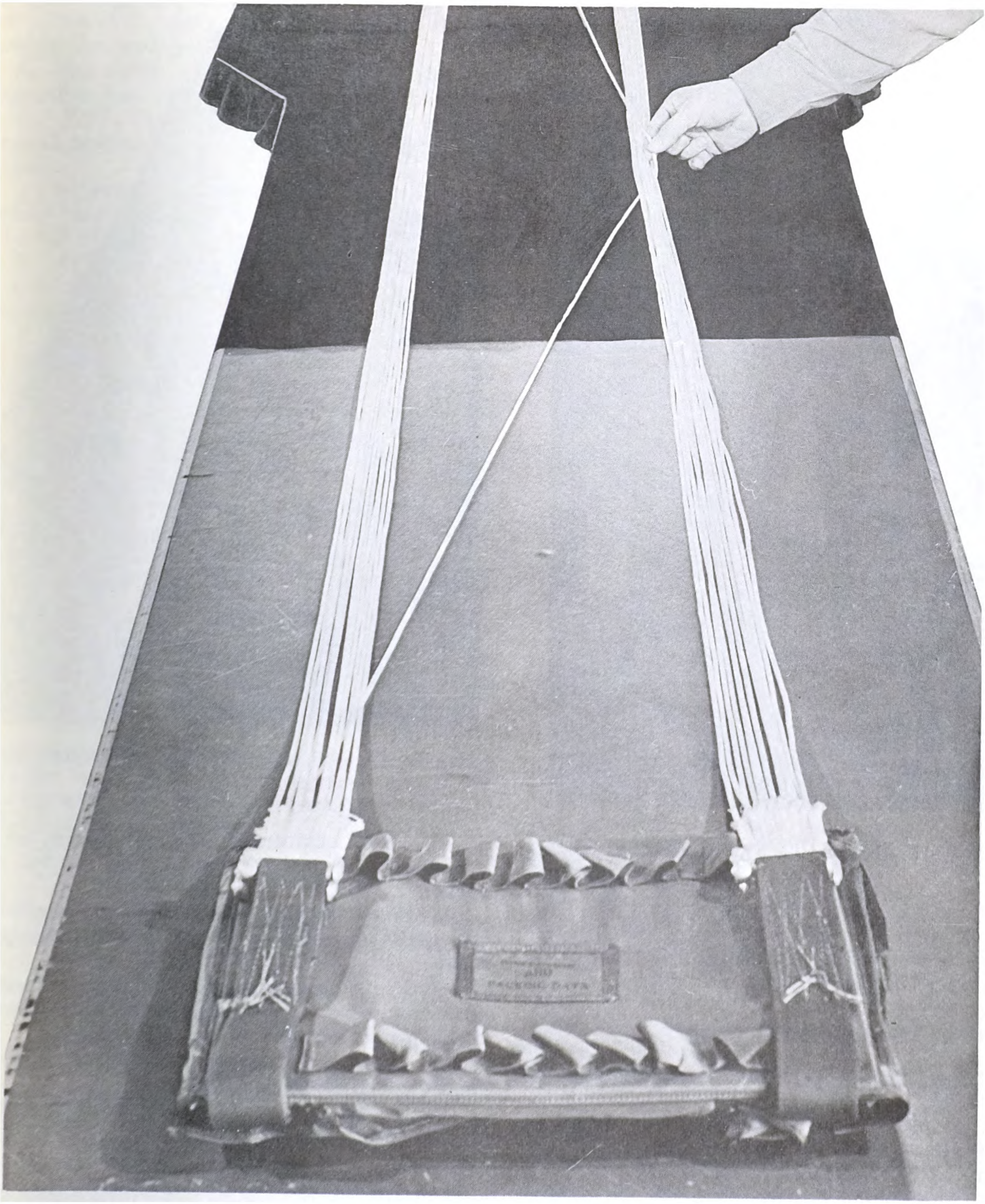


Figure 4-14.—Grasp the fouled line where it crosses over the right group and branches off to the canopy.

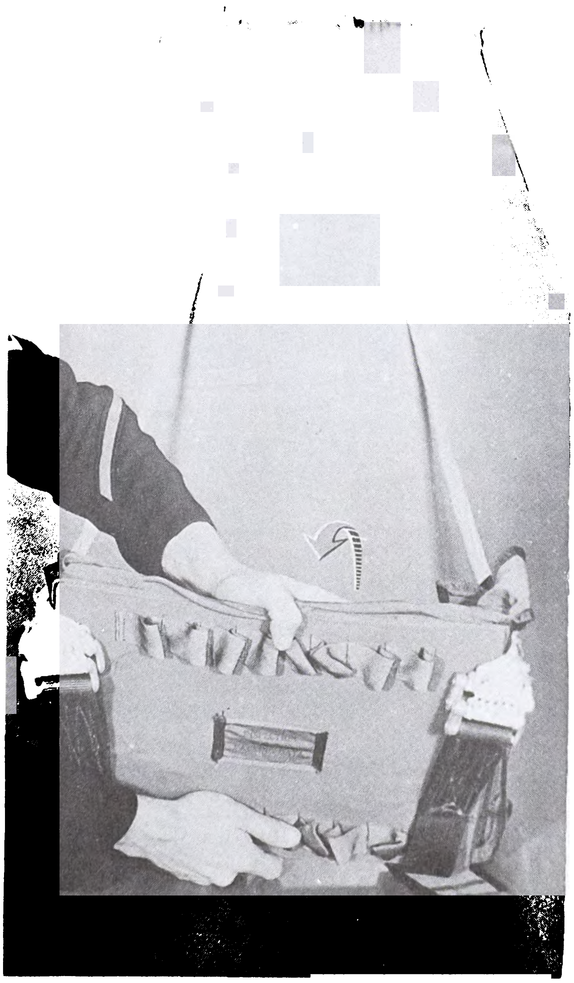


Figure 4-15.—Removing the simplest entanglements last. When the foul comes off between the groups (in), turn the pack DOWN. When the foul comes off outside the groups (out), turn the pack UP.

Dry Locker Procedure

The following steps are recommended as proper dry locker procedures:

1. Maintain a schedule so as not to take up space for a needless length of time. Do not use the dry locker as a warehouse.
2. If possible, arrange to have parachutes ready for packing when they leave the dry locker. Perform any repairs required before hanging the parachute.
3. Stencil parachutes as prescribed. Proper identification is important in their accounting.

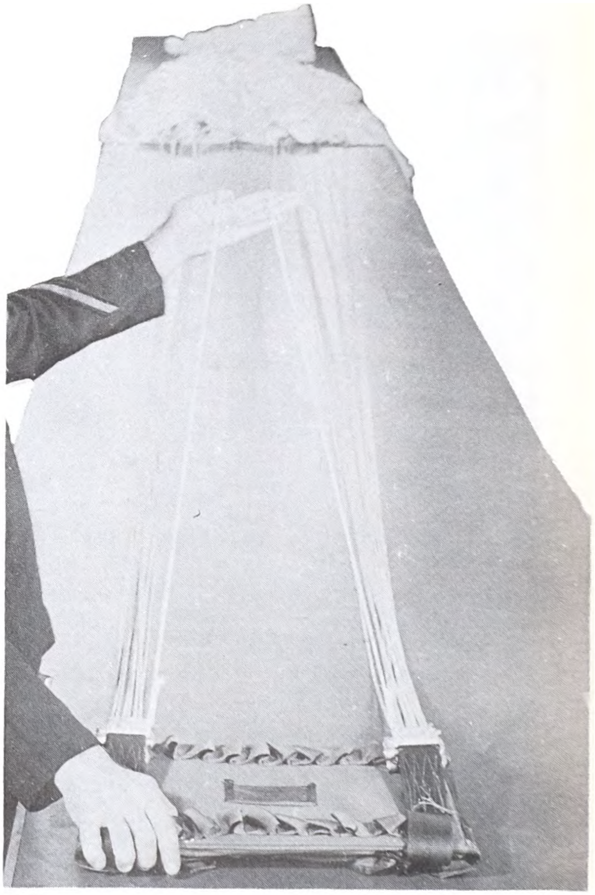


Figure 4-16.—Checking for entanglements; lines clear.

4. Avoid scattering; when possible, group parachutes in one or two sections of the dry locker.
5. Keep the canopy and lines off the floor. Place the harness and pack on a smooth-topped table.
6. Avoid hanging more than one parachute to a line. A parachute should have a minimum of 2 square feet (plane) for drying space.
7. Avoid unnecessary opening of doors in an air-conditioned dry locker.
8. Do not hang wet parachutes in the same space with dry parachutes.

Readying the Parachute Prior to Suspension

It is good practice to inspect the parachute prior to hanging it. Packing can then proceed without interruption. When possible, the parachute should be repaired and dried, then packed the following day. The *Parachute Manual*, NavAer 13-5-501, sets forth acceptable drying periods for emergency conditions.

In the event a table is not available for inspection and repair prior to airing the parachute, the following procedures are recommended and may be performed under the hoisting line:

1. Release the pack opening bands and secure the free ends to prevent them drawing back out of reach.
2. Pull the ripcord to release the canopy. Secure the grip to a harness snap temporarily for safekeeping.
3. Attach the snaphook, or similar fixture, of the hoisting line to the peak of the canopy through the suspension lines.
4. Raise the canopy to shoulder level, grasp the skirt, and proceed to shake out the folds. The vane type pilot chute will take care of itself. It cannot be held in a compressed state.
5. In the event the dry locker is not high enough to accommodate the canopy and suspension lines at full length, it will be necessary to chain the suspension lines and secure the harness and pack off the floor.
6. After the airing period, lower the parachute directly on to the pack, faking the lines and cloth gently while preventing contact with obstructions or the deck.
7. Always carry an unpacked parachute carefully. Do not permit the cloth to become snagged on rough surfaces. Always check the cleanliness and smoothness of any surface before setting a parachute down.

Chaining Suspension Lines

Chaining is for the purpose of shortening suspension lines, thus preventing damage and entanglement during suspension of the parachute. Figure 4-17 illustrates the steps in chaining a suspension line.

Knots

Figure 4-18 illustrates the method of tying the overhand knot, the square knot, the bowline knot, the surgeon's knot, the fisherman's knot, and the half hitch. These knots are in constant use. The surgeon's knot is used to secure tackings; however, the fisherman's knot may be substituted in places where the tacking will be subjected to more frequent stress and handling. The clove hitch and the half hitch are used at the removable connector links to secure the ends of the suspension lines. Half hitches are also used to secure the safety tie around the locking pin of a ripcord.

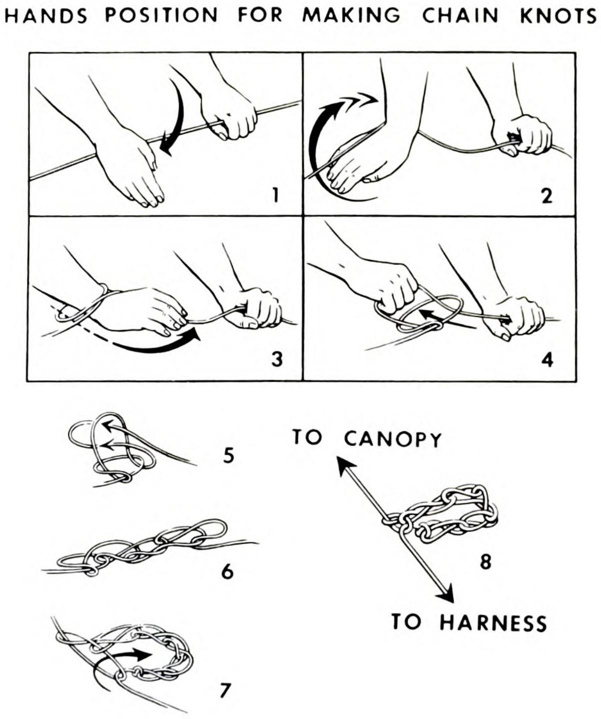


Figure 4-17.—Steps in chaining lines.

HANDLING PACKED PARACHUTES

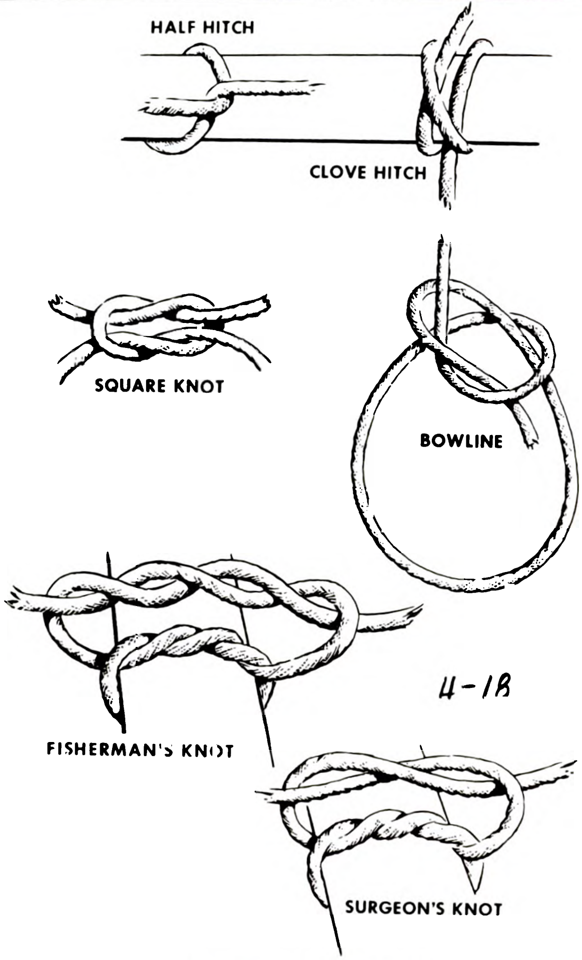
The most effective way to explain the subject of handling packed parachutes is to list a series of general rules in the form of DO'S and DON'TS.

1. Do not pick up a parachute by its lift webs or ripcord handgrip. Lift web tackings break relatively easy and when they do, the suspension lines are almost certain of disarrangement. Carrying or attempting to carry a parachute by its ripcord grip will always result in a premature opening.

2. Do not place a parachute near any source of heat. Heat will cause brittleness in nylon fabric.

3. Do not place a parachute in or near any source of dirt, grease, or oil. Stains can be extremely harmful to fabrics when they contain strong acids or alkalies.

4. Do not drop a parachute. Dropping a parachute can bend or break the metal components and perhaps cause failure of the entire assembly.



4-18

Figure 4-18.—Knots.

5. Do not leave a parachute where it is likely to get wet.

6. Do not leave a parachute where heavy objects can be dropped or placed on it. Permitting a parachute to be carried in a cargo net along with squadron cruise boxes or similar gear displays poor handling techniques.

7. Use the chafing bag to cover the parachute when it is expected to be kept out of service for a considerable amount of time.

8. Be prepared to give brief lectures instructing personnel on how to handle parachutes.

Figure 4-19 through 4-22 illustrate the best methods of carrying packed parachutes when rigged with and without the pararaft kit.

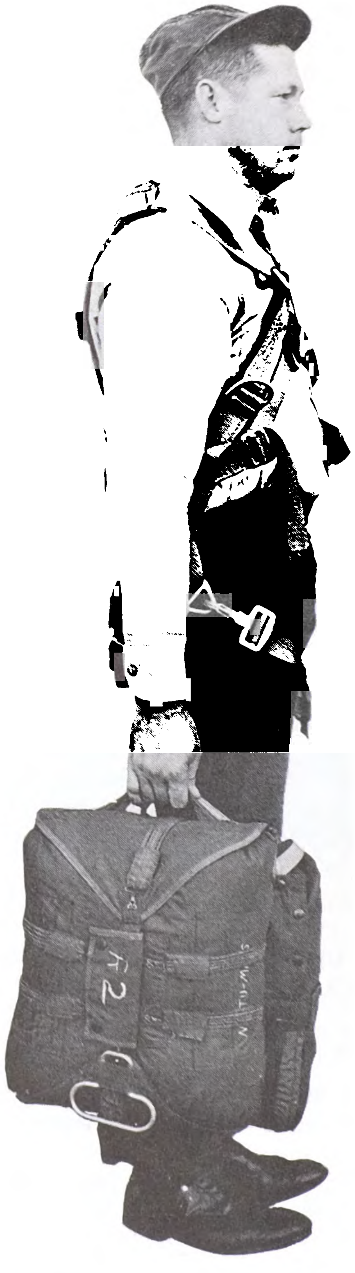


Figure 4-19.—Method of carrying the chest type parachute with or without the pararaft kit.

Chafing Bags

The parachute chafing bag, closed with two long slide fasteners, provides ample stowage protection for the parachute in a packed or unpacked condition. The slide fasteners, when opened, offer a large cavity capable of receiving any standard size parachute. The basic rules for stowing a parachute in the chafing bag are:

1. Chain the suspension lines.
2. Place the harness in the bag first.

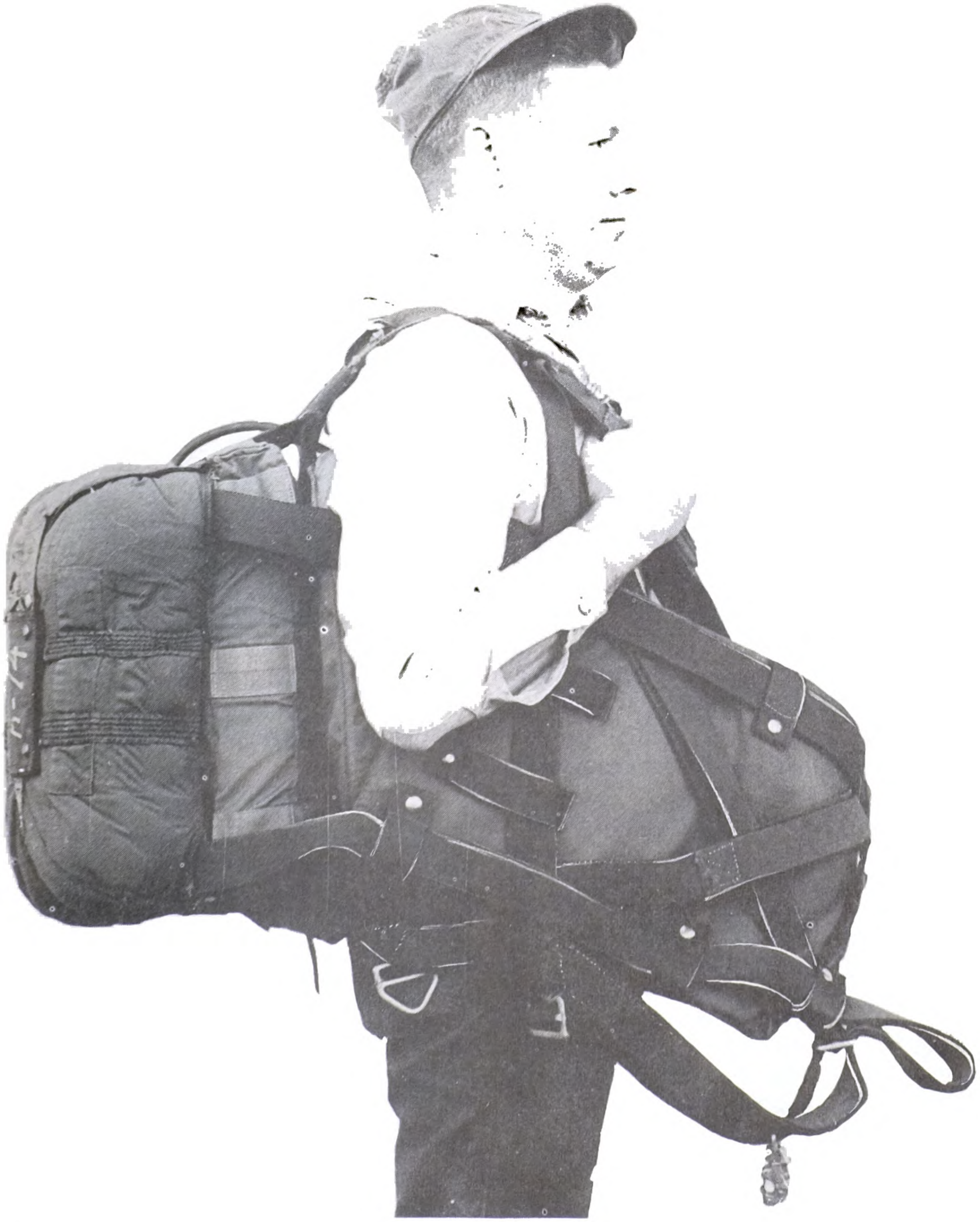


Figure 4-20.—Method of carrying the seat type parachute when rigged with or without the pararaft kit.

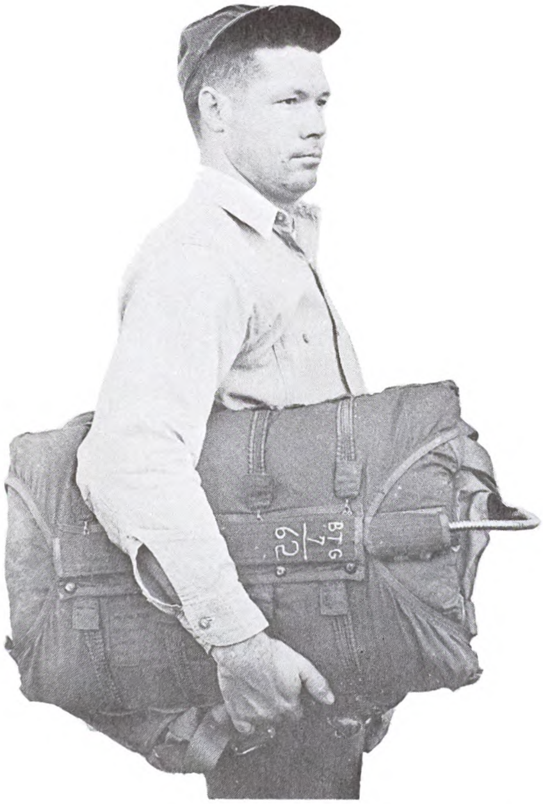


Figure 4-21.—Method of carrying the back type parachute without the pararaft kit.

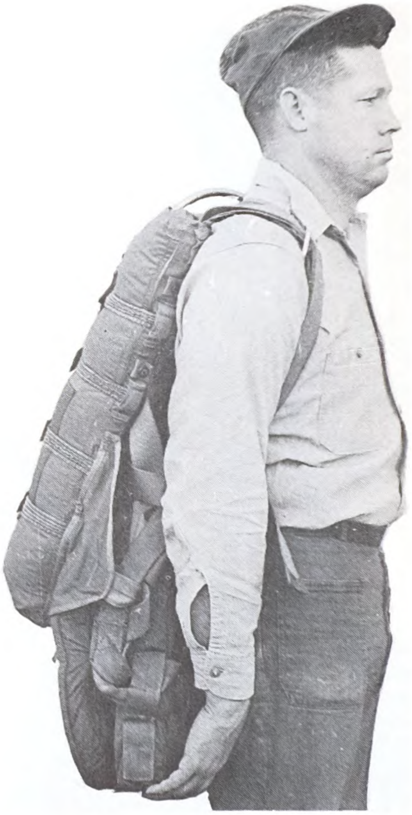


Figure 4-22.—Method of carrying the back type parachute when rigged with the pararaft kit.

3. Let the pack act as the separator between the canopy and hardware.
4. Accordion pleat the canopy into the bag.
5. When appropriate, and for very short periods in transit, compress the pilot chute into the bag, using the side as a backstop for the top of the pilot chute. Otherwise, disengage the pilot chute and stow separately.
6. Be careful when closing the bag and do not catch the canopy fabric in the slide fasteners.
7. Do not stow the bag directly on the floor.
8. Make certain that the bag is properly stenciled or tagged for identification purposes.

Shipping Cans

Parachutes are shipped from the manufacturer in sealed cans and may remain in the shipping can as long as it is not bent, crushed, or ruptured. Once opened, a parachute should be placed in service, or placed in a chafing bag for stowage.

Safety Precautions

Extra care must be given to the subject of handling packed parachutes on the line. Since the plane captains are the men who are most frequently required to handle the parachutes, other than Parachute Riggers, extra instruction should be directed to the plane captains in particular. It is part of your job as a Parachute Rigger to properly instruct the personnel who come in daily contact with lifesaving equipment. Acquaint every member of your squadron with the advantages as well as with the dangers involved in handling a packed parachute.

Cockpit enclosures are being improved for watertightness, but somehow rain does manage to enter the cockpit and settle in the bottom of empty bucket seats. Familiarize everyone with this fact and show them where you enter into this picture as well as themselves. Never place a parachute in a wet seat. Do not leave parachutes in aircraft exposed to the weather unless you or the plane captain have taken some added precaution to protect the parachute from water damage. Certain squadrons are often divided into detachments which operate in various localities away from the Parachute Rigger. The care of parachutes involved in these operations depends on how well you, the Parachute Rigger, have performed the job of familiarizing personnel with their parachutes.

Do not permit the plane captains to place a parachute on the wing or tail surfaces of an aircraft. This practice, if permitted, can lead to a great deal of extra work due to the damage inflicted by falls, dirt, and oil. Insist that the parachute be immediately placed in the seat of the cockpit.

Do not permit the parachutes to be hauled around on dirty bomb trucks, trailers, and the like. Discourage the practice of handling parachutes on plane tractors. This type of transportation neither offers a very stable platform nor is it clean.

Seat type parachutes rigged with a bailout cylinder can be a big source of trouble if they are handled carelessly. Take time to check everyone out so these easily activated cylinders will not be accidently expended.

Make certain that every plane captain knows how to safely carry the seat type parachute over his shoulder with his hand through the grip, locking it in its pocket. (See fig. 4-20.) Carrying the seat type parachute over the shoulder protects the parachute and permits the carrier greater freedom of movement and safety.

QUIZ

1. The most popular sail needle sizes used in parachute work are
   a. 12-14
   b. 14-16
   c. 16-18
   d. 18-20

2. Proper sail needle sizes should be selected to insure
   a. speed
   b. efficiency
   c. the prevention of damage to the material
   d. all of the above

3. The better grades of needles are issued in specially treated paper packages colored
   a. black
   b. green
   c. yellow
   d. red

4. The needle not considered to be a common type used for general hand sewing is the
   a. crewel
   b. sharps
   c. points
   d. betweens

5. The method considered to be best in removing fouls in a parachute is called the
   a. one line method
   b. two line method
   c. right and left method
   d. overhand method

6. If the suspension lines on a parachute are knotted, first
   a. hook up the links
   b. remove the knots
   c. remove the links
   d. hook up the peak

7. A parachute canopy should be aired and dried for a period of___hours.
   a. 18
   b. 24
   c. 36
   d. 48

8. Repairs should be made on a parachute
   a. before hanging in the dry locker
   b. after hanging in the dry locker
   c. before being repacked
   d. before being issued

9. The word that describes the ability of nylon fabric to absorb and retain moisture is
   a. porosity
   b. resiliency
   c. hygroscopic
   d. permeability

10. Suspension lines are secured to connector links by means of a
    a. double half hitch
    b. clove hitch
    c. clove hitch and one half hitch
    d. clove hitch and two half hitches

11. The identification number of the Parachute Manual is
    a. NavAer 13-501
    b. NavPers 5-501
    c. NavPers 135-501
    d. NavAer 13-5-501

12. Half hitches are used to secure the
    a. locking pins
    b. connector links
    c. butterfly tacking
    d. chest strap

13. To shorten suspension lines when hanging in the dry locker,
    a. knot the lines
    b. leave lines in the hesitator loops
    c. chain the lines
    d. tie the lines in loops

14. When hanging a parachute, the pilot chute will be left
    a. compressed
    d. dangling
    c. removed
    d. disregarded

15. Carrying or attempting to carry a parachute by its ripcord grip will always cause
    a. broken tackings
    b. premature opening
    c. broken safety tie
    d. disarrangement of lift webs

CHAPTER 5

PACKING AND RIGGING THE CHEST TYPE PARACHUTE

The Navy standard chest type parachute is designated as the NC-3 (Navy chest, third modification) parachute and is referred to as the NC-3 throughout this chapter.

The NC-3 has a 28-foot canopy constructed of ripstop nylon. A quick-fit harness (described later) is used in conjunction with the NC-3 parachute.

The NC-3 is rigged and packed by the Navy-approved two-man method. The average time of rigging and packing will vary, depending on experience, and the ability and skill of the team in working together.

The NC-3 is used primarily in transport and patrol type aircraft. The advantage of the NC-3 in this type aircraft is moveability, as the crewmen ordinarily wear only the harness during flight. With the quick-fit harness, assignment of stowed parachute, and the ease of attaching the chute to the harness, the crewmen can be ready for bail-out in a matter of seconds.

Rigging the Chest Type Parachute

PREPARATION

The following steps are recommended methods for rigging the chest type parachute:

1. Clean the table so that abrasives or other foreign matter will not come in contact with the parachute.
2. Lay out the packing and rigging tools. Packing tables are generally fitted with a tensioning device to hold the parachute during certain stages of packing. These should also be in position. (See fig. 5-1.)
3. Lay out the parachute. The lift web assembly, in this case, is not tacked to the pack. It is not always necessary, prior to packing, to break and remake the tackings that go together in the rigging of certain appendages.

We are starting from the unrigged condition so that all the rigging problems can be adequately covered.

PROCEDURE

If the suspension lines are chained, slip the securing hitch as the helper makes ready to pull the peak to the end of the table. As this is done, the suspension lines unchain, and by the time the peak of the canopy has reached the end of the table, the suspension lines will be completely free. Figure 5-2 illustrates the proper attitude of the lift web assembly, preparatory to assembling it to the peak. The packer's station is on the left side of the table, the helper's station is on the right side. (This is viewing the table from the packing end.)

Check the assembly for entanglement. Make sure that the canopy is turned right side out, that the lift web assembly is constructed properly and contains no twists, and that the suspension lines are free from fouls. A quick check of the two top inboard lines, as described under "Suspension Line Entanglements," and "Removing Entanglements," chapter 4, will complete the check. Hook up the lift webs to make a quick check of the suspension lines. The helper can hold the peak of the canopy and observe the position of the nameplate on the top gore while the packer lifts the two top inboard lines from the opposite end of the assembly.

The tongues of the quick connector snaps of the lift web assembly should be up (fig. 5-2). Note the stencil marking TOP with arrows on either side; cross connector straps carry this information which is intended to aid the wearer in connecting the parachute to his harness.

Harness to Container

To attach the pack to the lift web assembly, position as shown in views (A) and (B) of figure

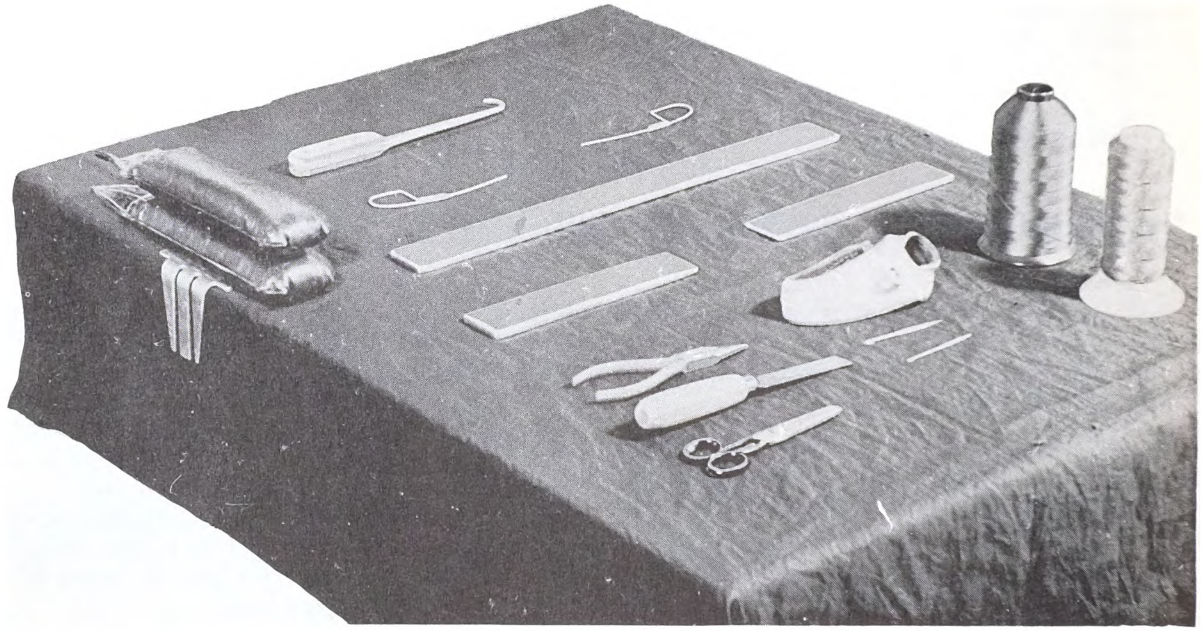


Figure 5-1. — Tools and equipment in position ready for rigging and packing.

5-3. To make the BREAK TACKING refer to figure 5-4, which illustrates the tacking pattern.

The chest pack lift web assembly tacking must be very strongly made, as this attachment must hold the pack securely while the parachute is being worn and at the crucial time of egress from the aircraft. Do not tolerate a sloppy tacking. The quick connector snaps are meant to be held in place rigidly, thus facilitating ''hookup'' to the harness. Since this is the strongest ''break tacking'' used in service parachutes and must support the pack as well as break away, it is important that this tacking be drawn up tightly to prevent slippage, as shown in figure 5-4. After completing the lift web tackings, attach the pack opening bands to the pack. Use a pair of flat nose pliers to pinch the hook ends closed after they have been passed through the wire anchoring eyes of the pack. This will prevent loss of the pack opening bands. When only one end is hooked up as in packing, airing and drying, or at any other time, the parachute is inactive and unpacked. (See fig. 5-5.)

Rigging the Parachute Kit

The chest type parachute may be rigged with the pararaft kit at the discretion of the unit commander.

The rigging procedures follow:

Using a ''box X'' stitching pattern, sew three 3 1/2-inch lengths of 3/4-inch nylon tape to the parachute pack and pararaft kit container at the points indicated in figure 5-6. Fold each piece of tape before sewing to form a 1/2-inch loop through which is passed a 10-inch length tie, cut from type III suspension line.

When making tackings or sewings around the canopy and suspension lines, remove the canopy and suspension lines from the pack prior to any sewing or tacking operation. If you do not follow this rule, there is the danger of inadvertently sewing the canopy and lines to the pack.

Insert the pararaft kit into its container and engage the releasing mechanism. Make adjustments with the aid of the two adapters, making certain that the pararaft fits snugly in its container, but not so tight as to make the removal of the pararaft kit difficult in an emergency. Tack each adjustment with one turn of 6-cord nylon thread, single, immediately behind each adapter. (See fig. 5-7.)

Before packing the parachute, tack the lift web assembly—one turn each through edges of lift webs and around the pack frame. Use size E nylon thread. Tie off with a surgeon's knot. Note that the lift web assembly has been drawn out of the pack to its limit where the chafing

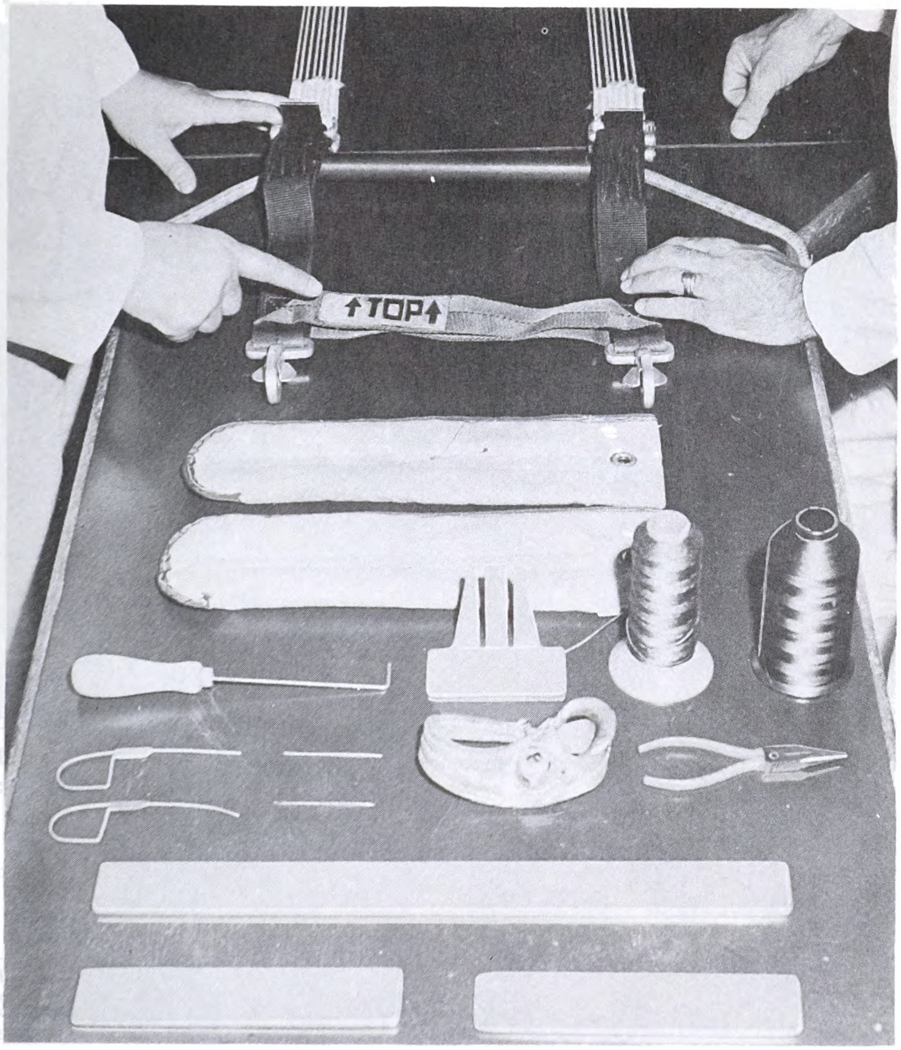


Figure 5-2.—Parachute laid out on the table. Packer on the left, helper on the right.

webbing has been doubled back on the risers. (See fig. 5-8.)

Pack the parachute, following the appropriate steps established for packing the chest type parachute without raft attachment.

Match up the packed parachute and pararaft kit assembly. (See fig. 5-9.)

Secure the corresponding loops of the parachute and pararaft kit assemblies (fig. 5-10), using the 10-inch nylon tie cords tightly square-knotted. Since the knotted nylon cords may slip and loosen, tack several passes of 3- or 6-cord nylon thread through the knots for security.

Secure the quick connector snaps to the pararaft kit container. (See fig. 5-11.)

The quick connector snaps are not as rigidly secured to the pararaft kit container as they were to the pack. However, they are tied as tightly as possible. A considerable amount of slack still exists in the pararaft kit container, as this assembly does not contain a frame for rigidity purposes as does the parachute pack. Extra care must be taken to properly engage the chest type parachute with the corresponding harness hardware when it is rigged with a pararaft kit. This knowledge must be imparted to those who may use one of these rigs. The complete assembly, properly worn, is shown in figure 5-12.

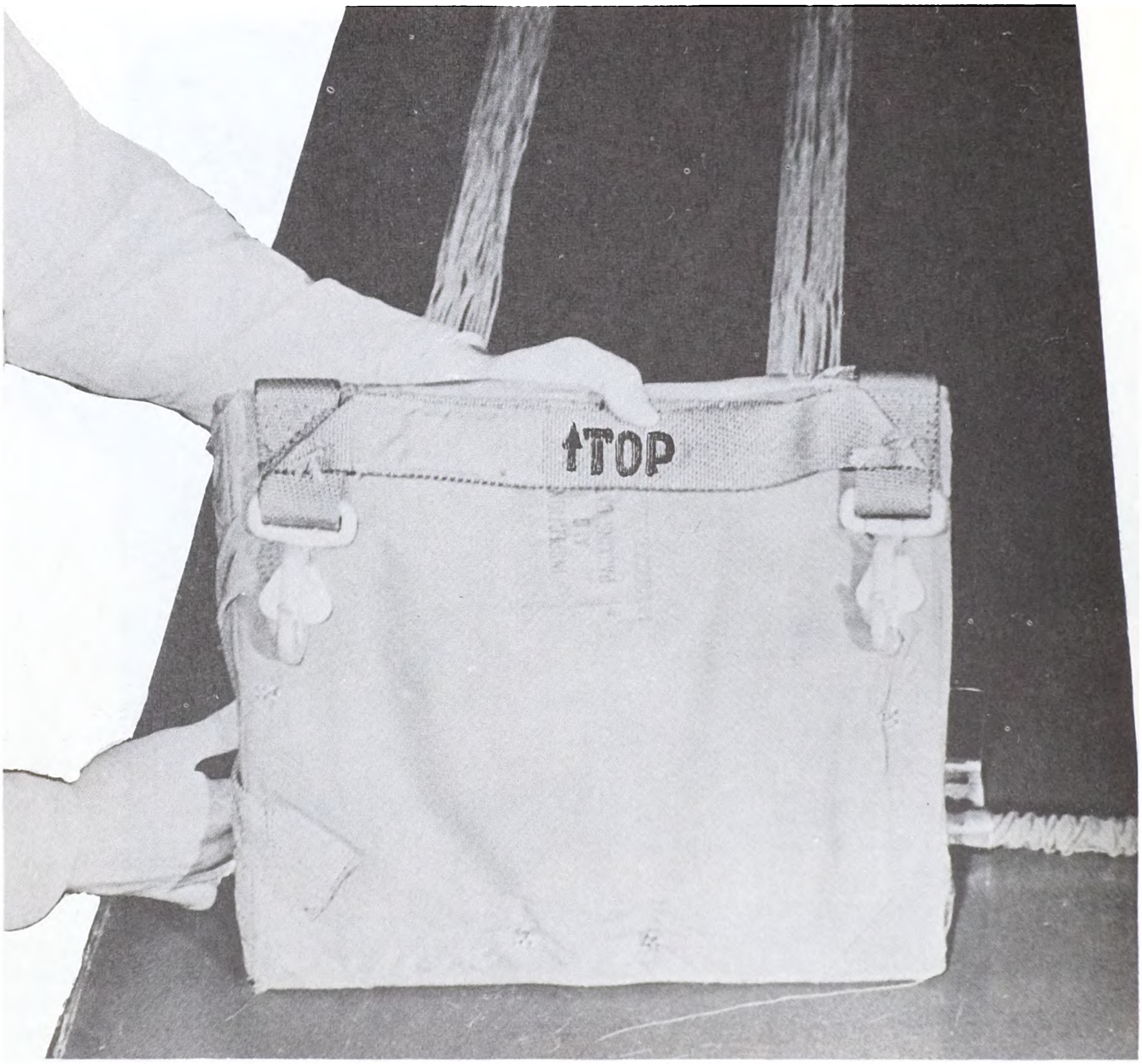


Figure 5-3.—Position of lift web assembly in relation to pack. (A) Outside view.

Inspecting Parachute For Packing

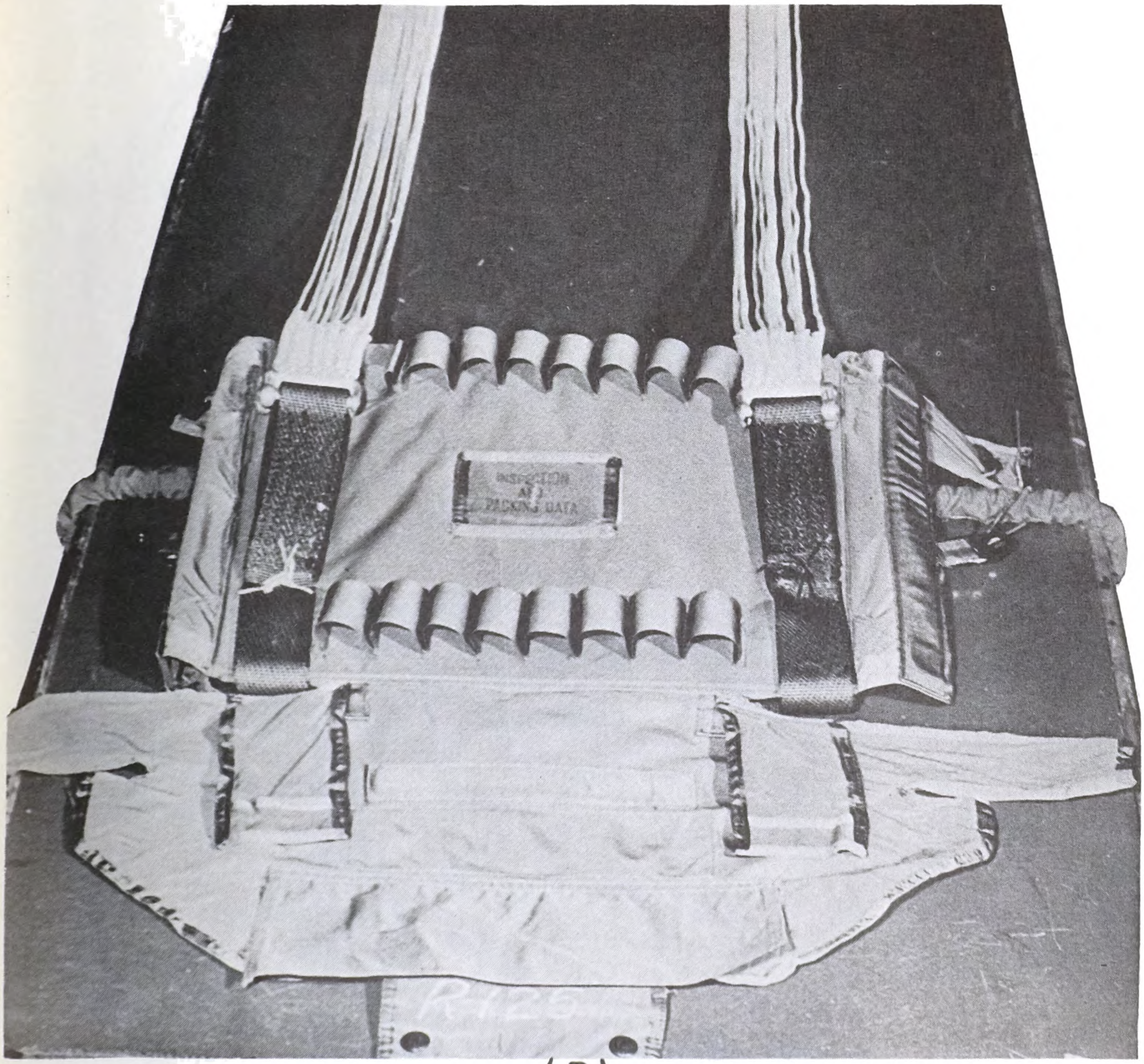
The inspection process actually involves inspection in two conditions: (1) When the parachute is not under tension; and (2) when the parachute is under tension. When the parachute is not under tension inspect the harness, lift webs, and all appendages, including sewing and tackings; also the pack and all appendages, including tackings.

When the parachute is under tension inspect the canopy (all sections, sewing, seams, and hems); suspension lines and all security points; and the pilot chute connection.

Inspection during the latter condition is carried out after the parachute has been hooked up. When time permits, remember it is the best policy to hold a complete inspection, making all minor repairs before hanging the parachute in the drying locker. In this way the packing process can be accomplished most expeditiously.

When the inspection process must be carried out at the same time as packing, due to scheduling problems, lay the parachute out on the table but do not hook it up.

Since there is no tension applied to the assembly, one will have all the freedom necessary to carefully inspect the pack, harness, and



(B)

Figure 5-3.—Position of lift web assembly in relation to pack. (B) Inside view.

the other small appendages. The harness and pack parts of the parachute receive the most wear. The canopy, if properly cared for, will last longer than the other assemblies. After the preliminary inspection, which is conducted at the harness end of the parachute, the entire assembly may be placed under tension and the canopy, suspension lines, and pilot chute may be given a final check. If damage to the canopy is discovered, it will be necessary to unhook the parachute and repair it, if possible.

Hook up the parachute. The packer passes the flat hooks of the spreader bar up through the connector links as the helper grasps the peak and walks to the opposite end of the table. When the hooks are in place and the spreader bar is secure, the helper applies a certain amount of tension at the peak prior to straightening the skirt hem. This operation is accomplished by manipulating the suspension lines at the peak while the packer directs the operation from the skirt of the canopy (fig. 5-13).

A perfect alignment of the skirt and vent hems is not always possible. One gore may be slightly longer than the other; the one-half inch of slack given the canopy at the skirt and over

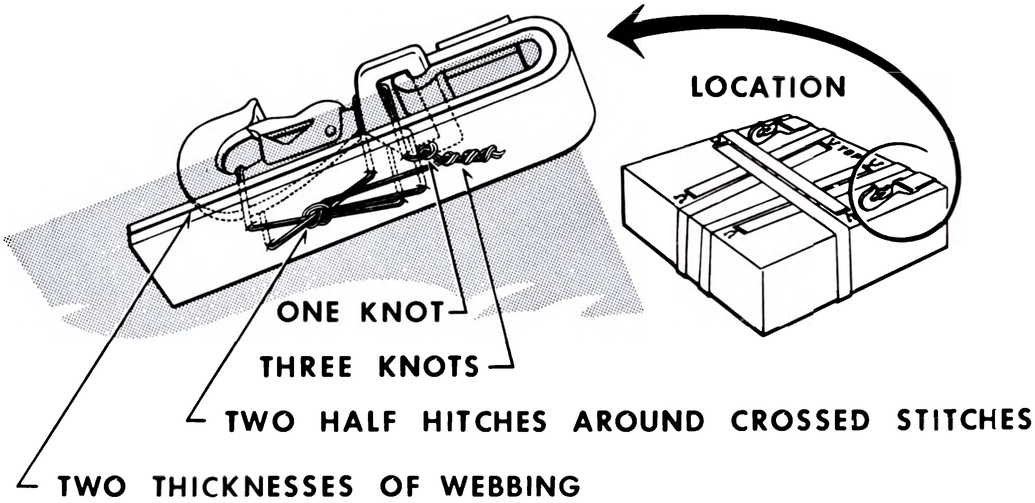

LOCATION
ONE KNOT
THREE KNOTS
TWO HALF HITCHES AROUND CROSSED STITCHES
TWO THICKNESSES OF WEBBING

Figure 5-4.—Chest type parachute, lift web and pack tacking.

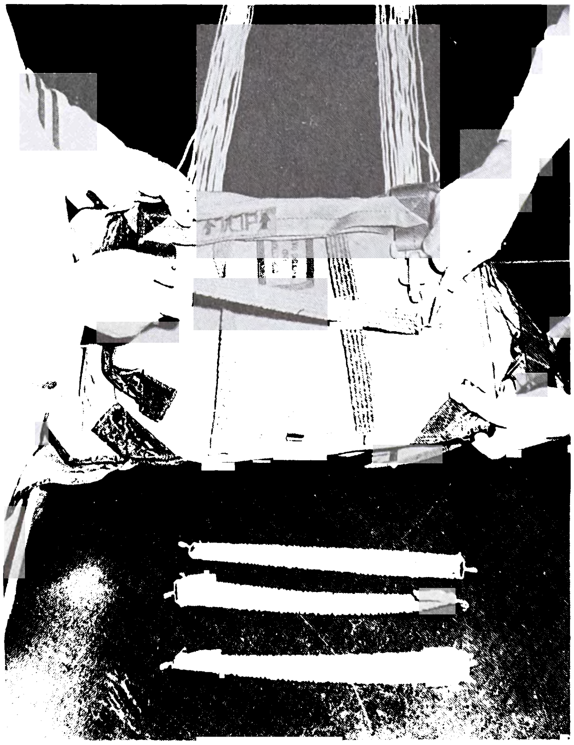
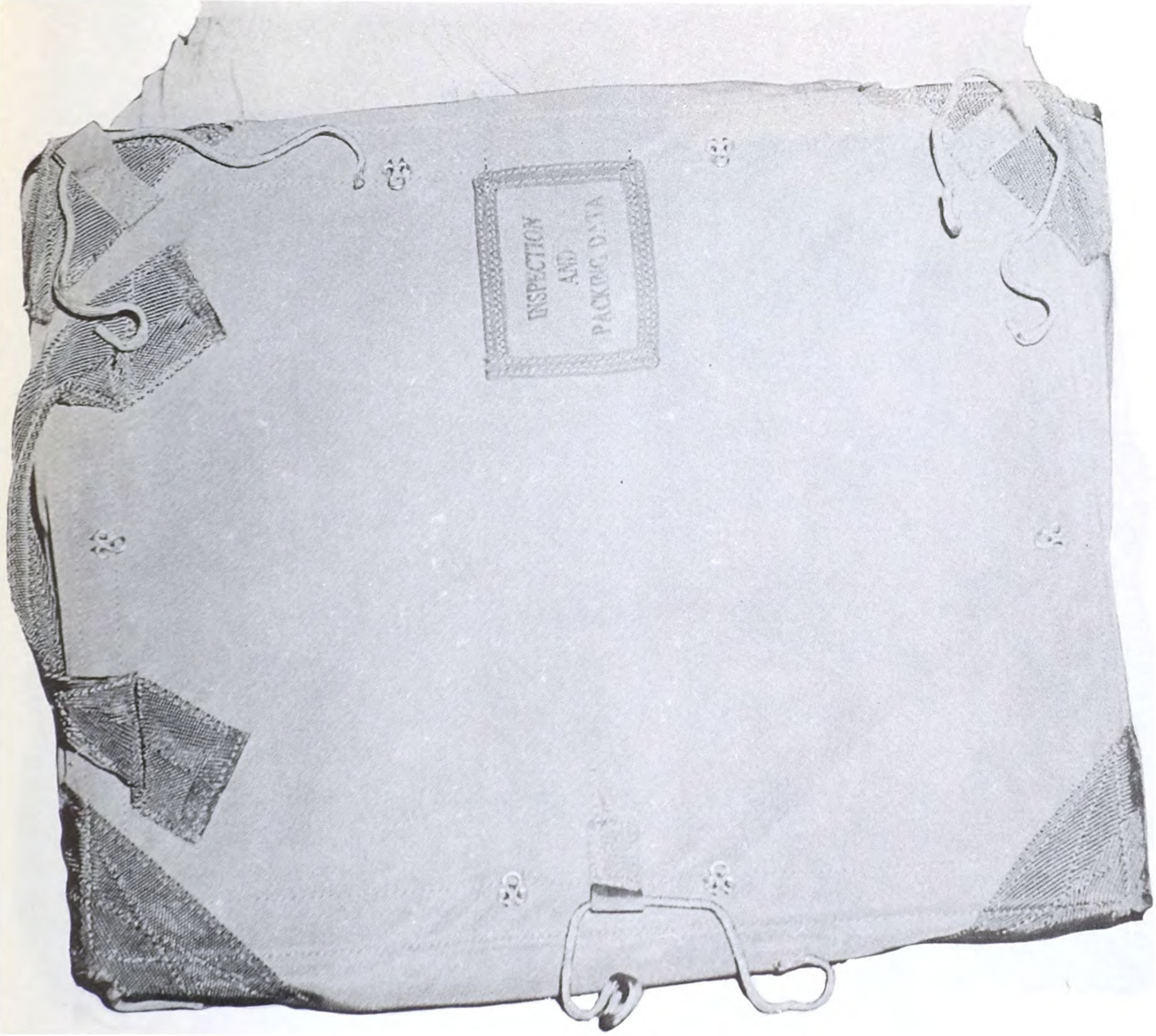


Figure 5-5.—Pinch the tips of the pack opening band hooks closed to prevent loss.

each suspension line may vary. Straighten the skirt, and if necessary, let the vent hem take the slightly irregular setting. Every effort should be made to straighten the skirt properly, and if an irregular alignment of the folded hem edges is too pronounced, turn the parachute in for major repairs.

Adjust the tension on the parachute to the point where the skirt hem can be raised to shoulder level without straining. Experience



(A)

Figure 5-6.—Position of tape loops for pararaft kit attachment.

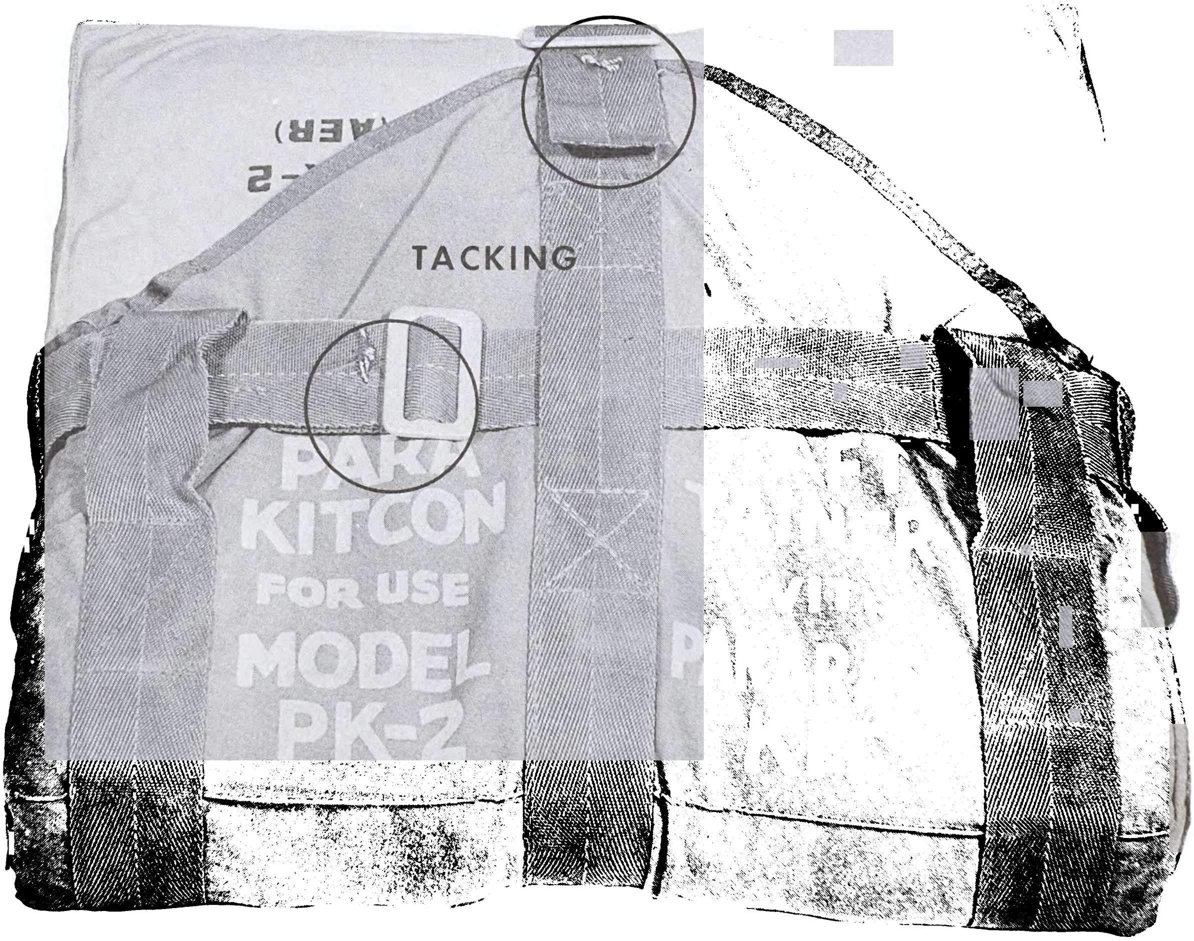


Figure 5-7.—Fit the pararaft kit container to the pararaft kit.

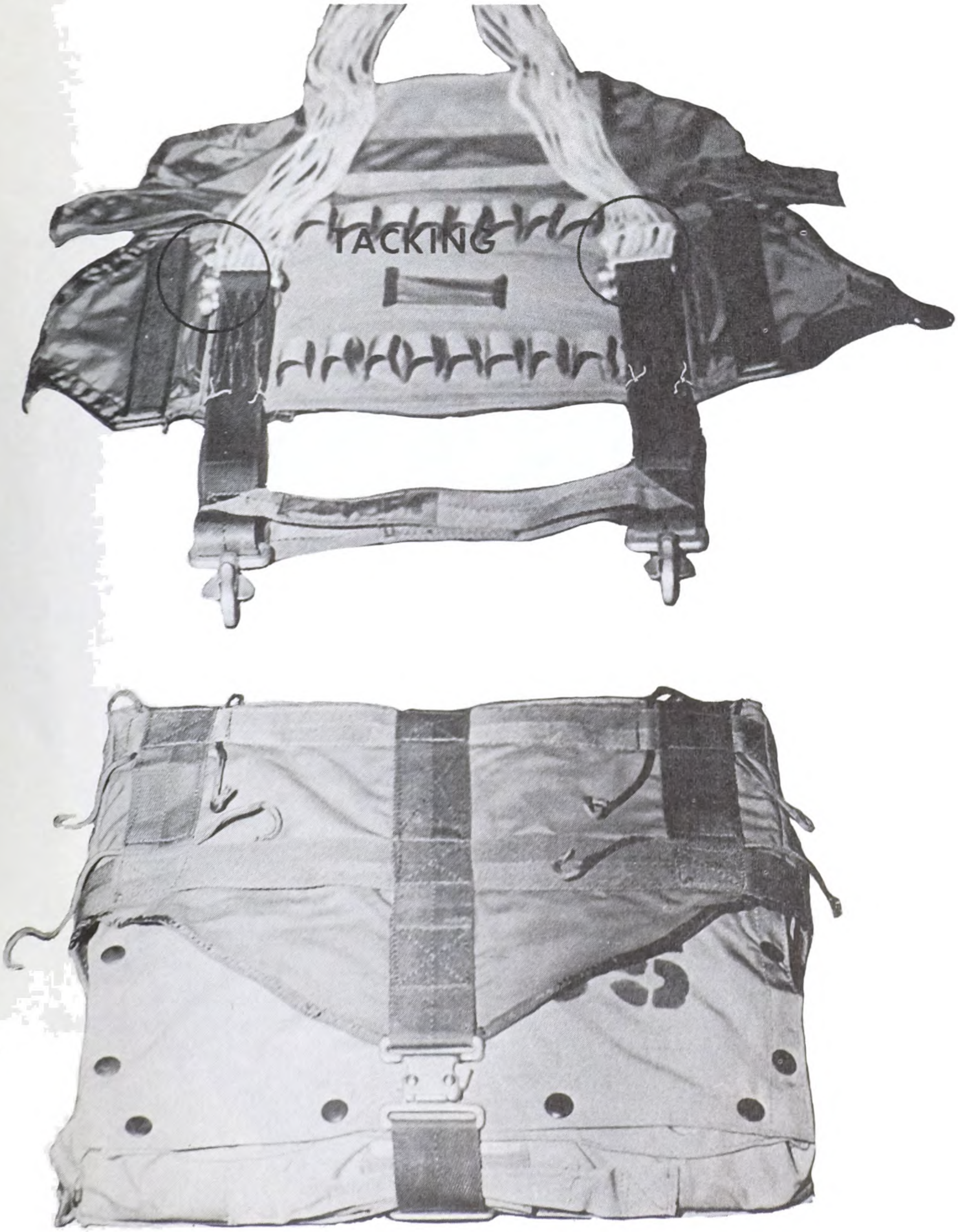


Figure 5-8.—Positioning and tacking procedure for a chest type lift web assembly when the parachute is rigged with a pararaft kit.

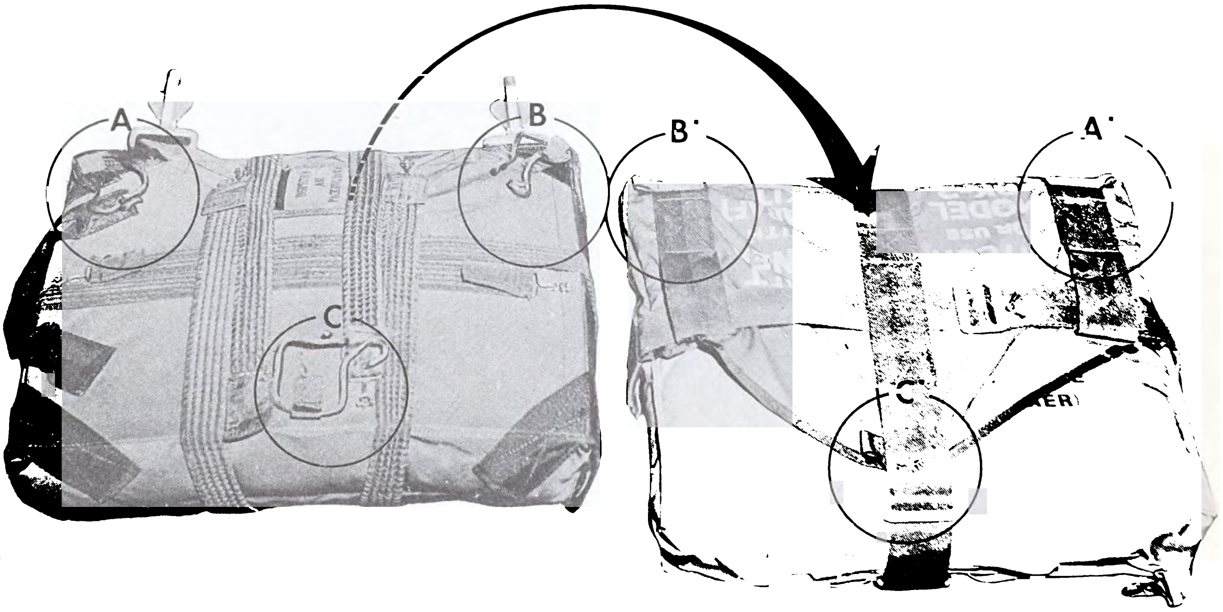


Figure 5-9.—Corresponding securing points between chest type pack and pararaft kit container.

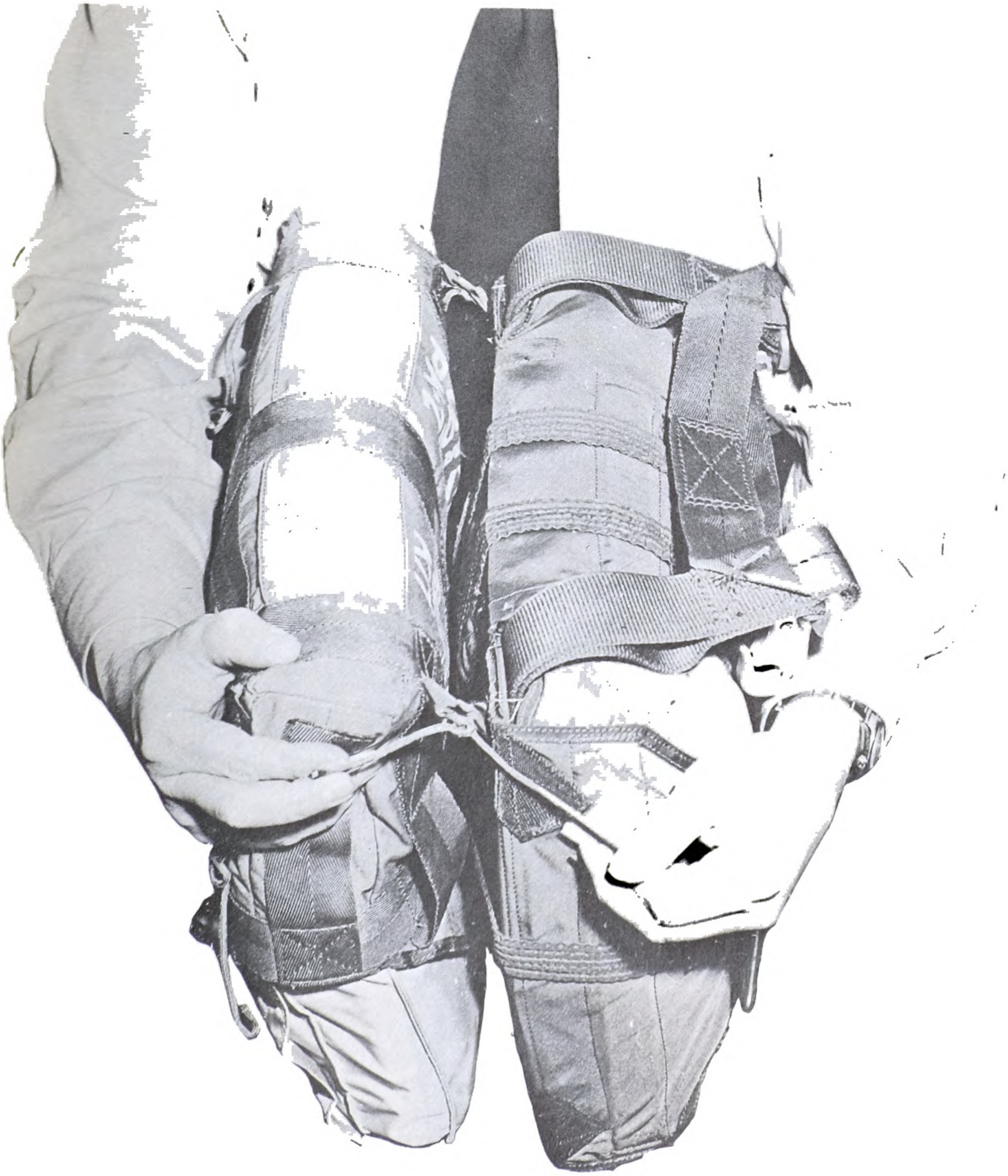


Figure 5-10.—Tie the pararaft kit container to the parachute pack.

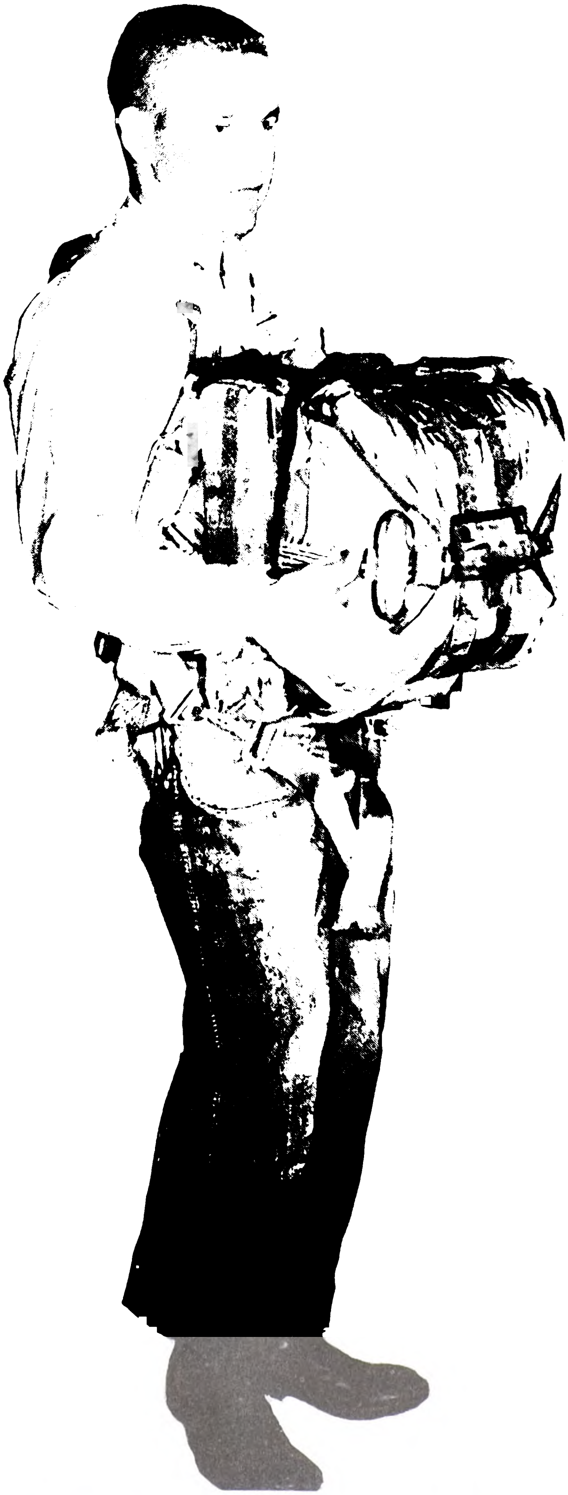


Figure 5-12.—Chest type parachute rigged with a pararaft kit.

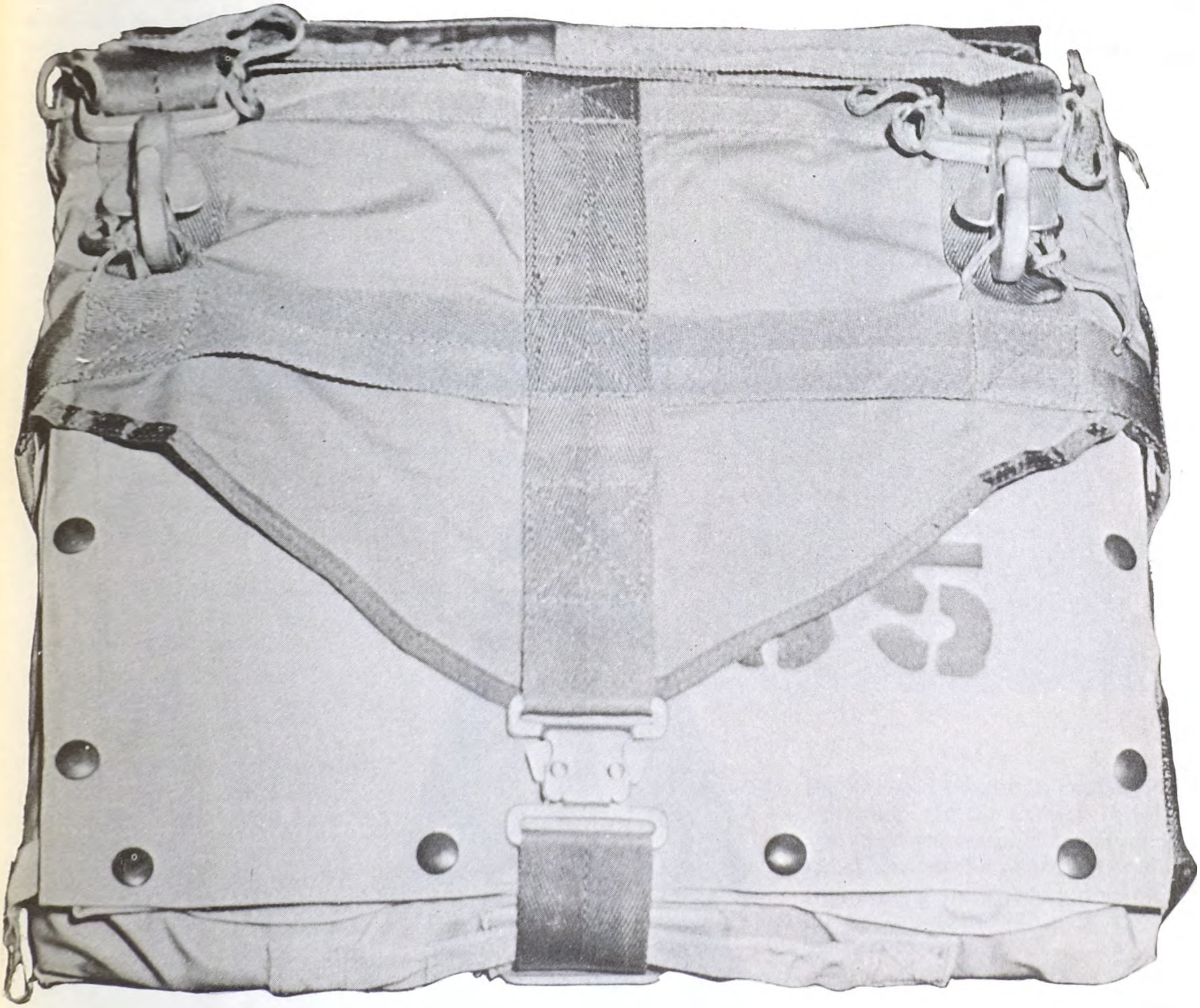


Figure 5-11.—Quick connector snaps secured to the pararaft kit container.

is the best teacher, as the desired tension will vary with the parachute and the individual. Figure 5-14 illustrates the chest type parachute under tension and ready for packing. All of the inspection steps should now be completed. Notice the seat cushion temporarily placed between the pack and table. This padding provides a good packing base which prevents the hardware tackings from loosening and the surface of the table from being scratched.

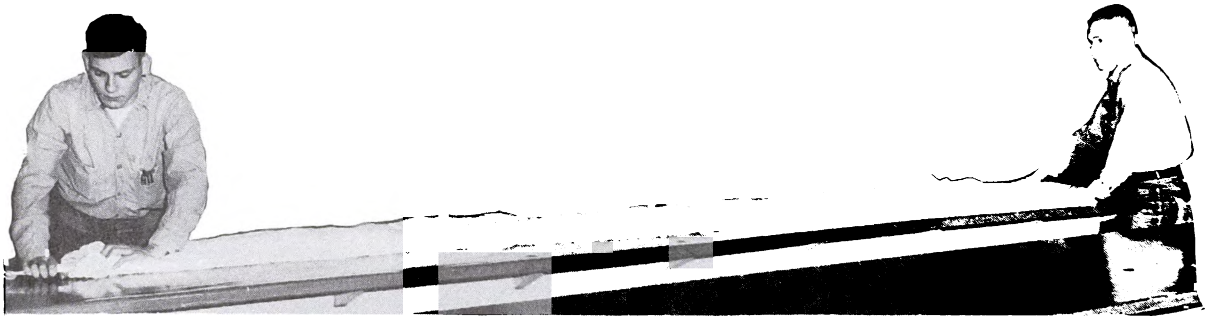


Figure 5-13.—Straightening the skirt hem.

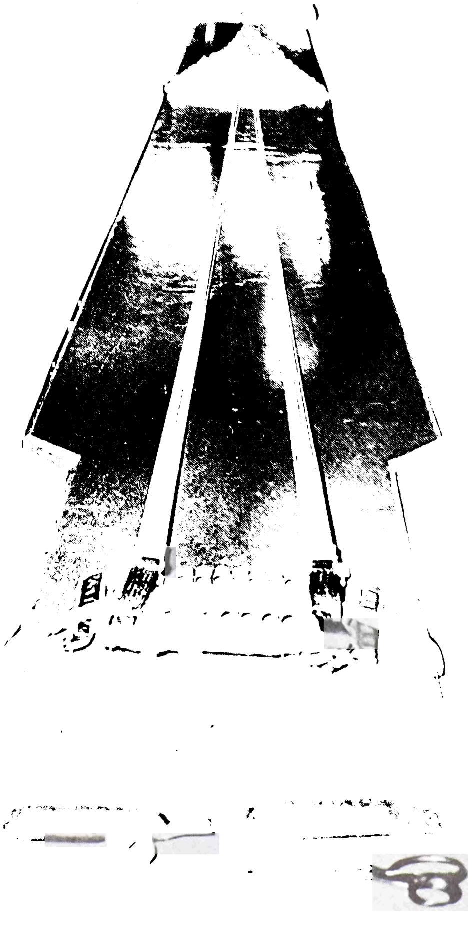


Figure 5-14.—Chest type parachute under tension and ready for packing.

Packing the Chest Type Parachute

PROCEDURE

Whip and fold the canopy. This operation reduces the unwieldy area of the cloth to a series of neat, consecutive folds. The packer and helper station themselves at opposite sides of the table and in line with the skirt hem. The packer will have two shot bags and a suspension line holder to aid him in neatly holding the folds of the canopy together after completion of this operation. The holder and bags can be placed near the edge of the table where they will be out of the way.

In beginning the operation, grasp the two top inboard lines (on each side of the top gore), glancing back at the links to make certain that the lines are running free and clear. The complete continuity of the lines should have been checked during the inspection process so it will not be necessary to do this again. Raise the lines to a level where the inside of the canopy can be clearly observed to the peak. (See fig. 5-15.)

Figure 5-16, views (A) and (B), illustrates the folding of each gore or section, except the top and bottom gores.

In making the last two folds in the top and bottom gores, swing the folded gores out beyond the table (fig. 5-17.)

The packer, while still holding the suspension lines in his right hand, reaches over the suspension lines with his left hand to the top center area of gore number 28 and prepares to draw a fold back over to his side of the table. The helper does the same with the bottom gore, but must reach under his group of lines preparatory to drawing the bottom fold back to his side of the table. On signal they both draw the folds in opposite directions while at the same time bringing the suspension lines to the center of the table. (See fig. 5-18, views (A) and (B).)

Since the last fold on the helper's side has to be made from the bottom, it is quite likely that the fold will need special attention to straighten it throughout its entire length to the peak. The suspension lines of each group may now be inserted in the respective slots of the suspension line holder. The packer now places a second shot bag across the skirt hems on his side while the helper casts all but one of his folds over on top of the packer's side. Note the shot bag placed across the suspension lines for the purpose of retaining the lines in the suspension line holder.

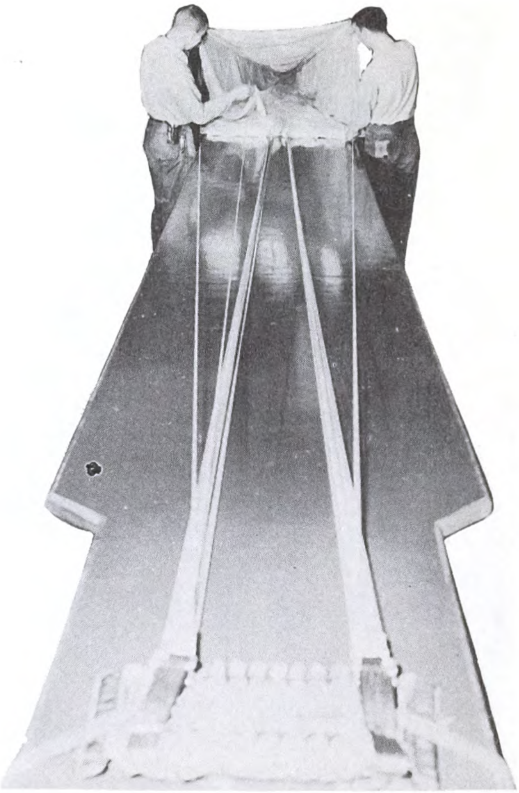


Figure 5-15.—Packer and helper in position to whip and fold the canopy. (Note action of each man's lower hand, which draws the next suspension line away from those gathered in the center of the table by the applied tension.)

Action is now begun to straighten the bottom fold and bring it out to the proper taper throughout its run to the peak. The packer may follow the helper or remain at his station throughout this operation, holding the suspension lines to the center of the table while permitting the tucked-under portion of the bottom fold to be brought out into position. (See fig. 5-19.)

After the bottom fold has been straightened, the packer makes ready to cast his folds to the helper's side after the shot bag has been shifted to the other group. All of the packer's folds may now be cast over on top of the helper's folds while he quickly brushes out the wrinkles throughout the length of the section. Do not use

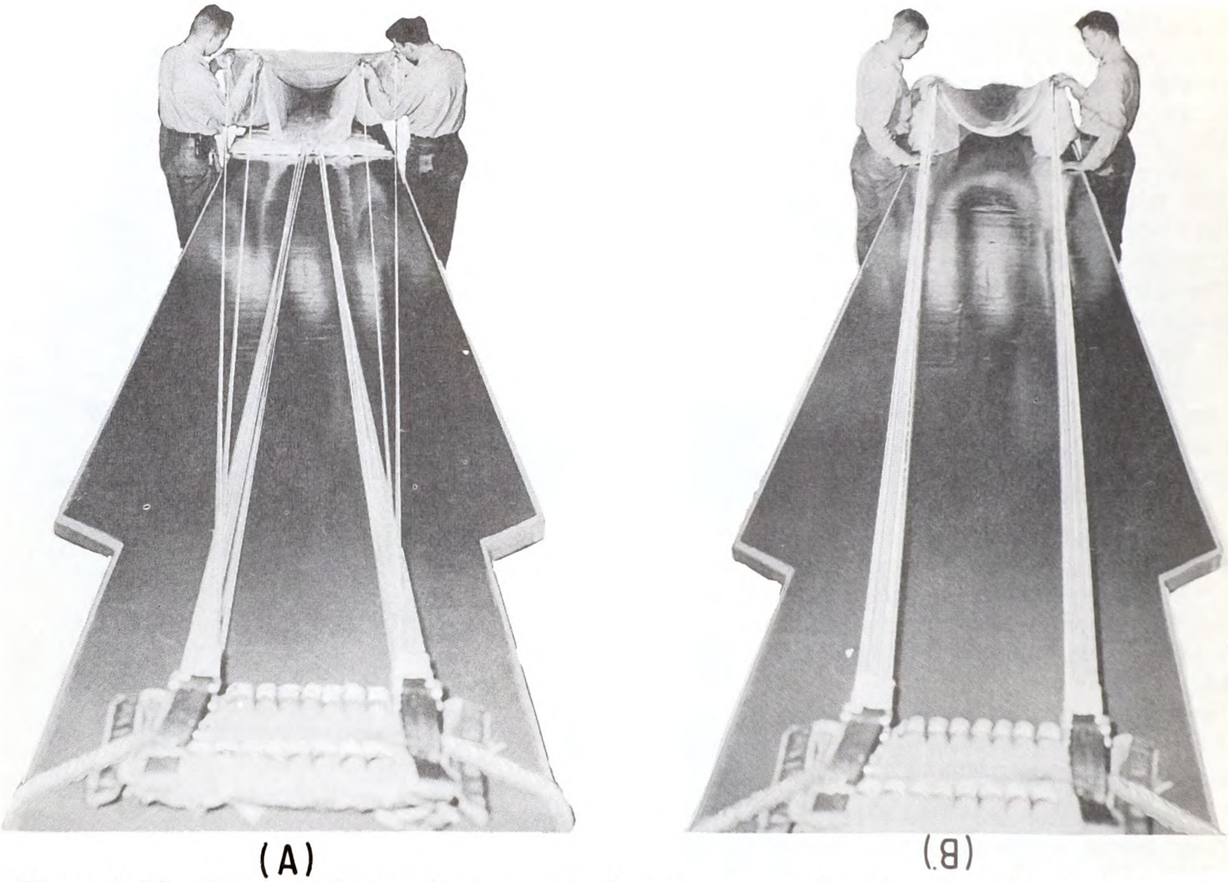


Figure 5-16.—Whip and fold each gore until all of the suspension lines have been taken up by the packing team. (A) First fold being made; (B) all folds made except top and bottom.

too much pressure in the brushing action or the fold on the other side will be brought through and require a complete recasting. (See fig. 5-20.)

The packer's folds are returned to their side of the suspension lines and the brushing action is again applied to both sides of the canopy folds. The shot bag lying on the helper's folds is removed and placed at the edge of the table. Figure 5-21 shows the canopy after all of the folds have been completed.

Experience enriches the fundamentals of any technique. Some Riggers believe that the only real way to pack a parachute is to do it by themselves. The novice at parachute rigging has to learn and practice all of the basic steps and principles of packing a parachute before he can safely be on his own. Develop accuracy first and speed second.

To straighten the skirt hem, grasp the folds of the skirt at the corners and fold back, as shown in view (A) of figure 5-22.

Align and count each fold until they are all neatly in place. Each group on either side of the suspension lines should have fourteen folds. (See fig. 5-22, view (B).)

The canopy is now ready to be folded in thirds. Remove the shot bag that is lying across the suspension lines. Take care not to disarrange the skirt as the folds are brought into position (fig. 5-23). Note the position of the shot bags. If the bag nearest the skirt is placed too close, it will pull the skirt back out of line.

Notice that the canopy cannot be folded in thirds throughout its entire length, but "breaks open" about one-half of the way to the peak.

The helper now unhooks the peak of the parachute. This is done carefully. A sudden release of the tension would disturb the canopy. The packer unhooks and removes the spreader

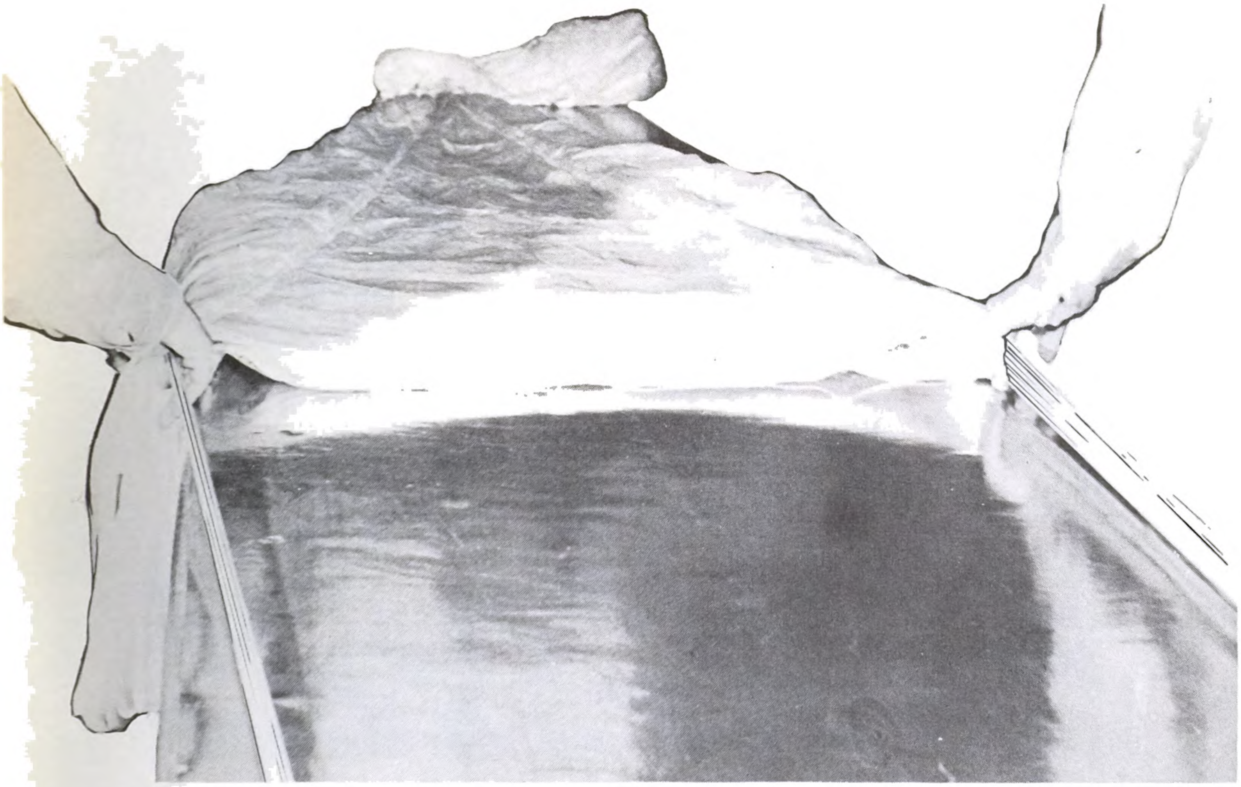


Figure 5-17.—Step I in completing the last two folds.

bar, if removable, and prepares to stow the suspension lines. Due to its awkwardness, the vane type pilot chute will not stay on the table as the canopy is pulled down to the pack. Before taking his station, the helper places the pilot chute on top of the canopy. Sign the inside Parachute Record Card and insert it in the pocket.

Stowing the suspension lines is the most difficult operation of the lot. There are so many things to watch for—dropped lines, twists, uneven stowage, tearing the pack, tearing or turning under the hesitator loops, and improper gaging of length. Figure 5-24 illustrates the most common errors.

The packer stows the lines while his helper prevents the pack from shifting. Taking the suspension line hook in the right hand, grasp all of the lines with the left hand, as shown in figure 5-25.

Bring the lines in a bight up to the first hesitator loop. Using the suspension line hook, henceforth referred to as the hook, draw the lines through the first hesitator loop and about an inch beyond the edge of the loop. (See fig. 5-26.)

The beginner should practice the procedures illustrated in figures 5-23 and 5-26 until he can gage the correct amount of lines to stow in the first hesitator loop and bottom of the pack. This operation is important. If too much line is stowed in the first bight, you will not be able to use all of the hesitator loops, and the length of line left between the skirt of the canopy and the last bight in the hesitator will probably be the wrong length. If an insufficient length of line is taken up in the first bight, the lift webs and links may be pulled in toward the center of the pack, and the result will be too much line left between the last bight and the skirt of the canopy.

Figure 5-27 illustrates the lines correctly arranged in the bottom of the pack. Notice how the suspension lines leading to the canopy are running free and alongside the lift webs. There is no twist here. Take care not to tuck the suspension lines under the lift webs.

The helper should assist in keeping the pack in the center of the table. He should help keep the pack stable and hold back on the suspension lines as the new bight is being taken.

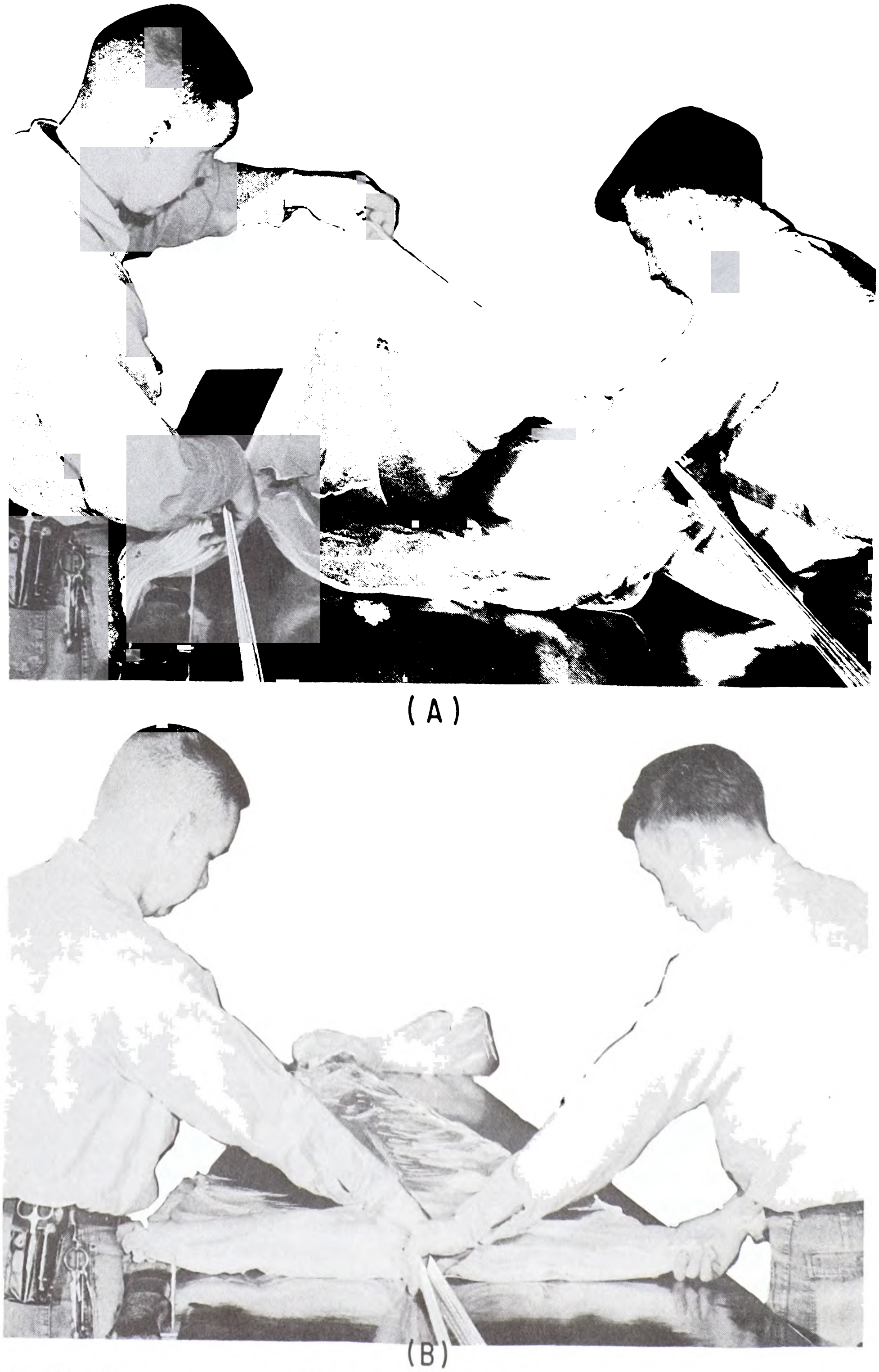


Figure 5-18.—Step II in completing the last two folds. (A) Gores being grasped in the center prior to moving lines to center of table and edges of folds to outer edges of table; (B) lines brought to the center and skirt hem folds brought out in the opposite direction.

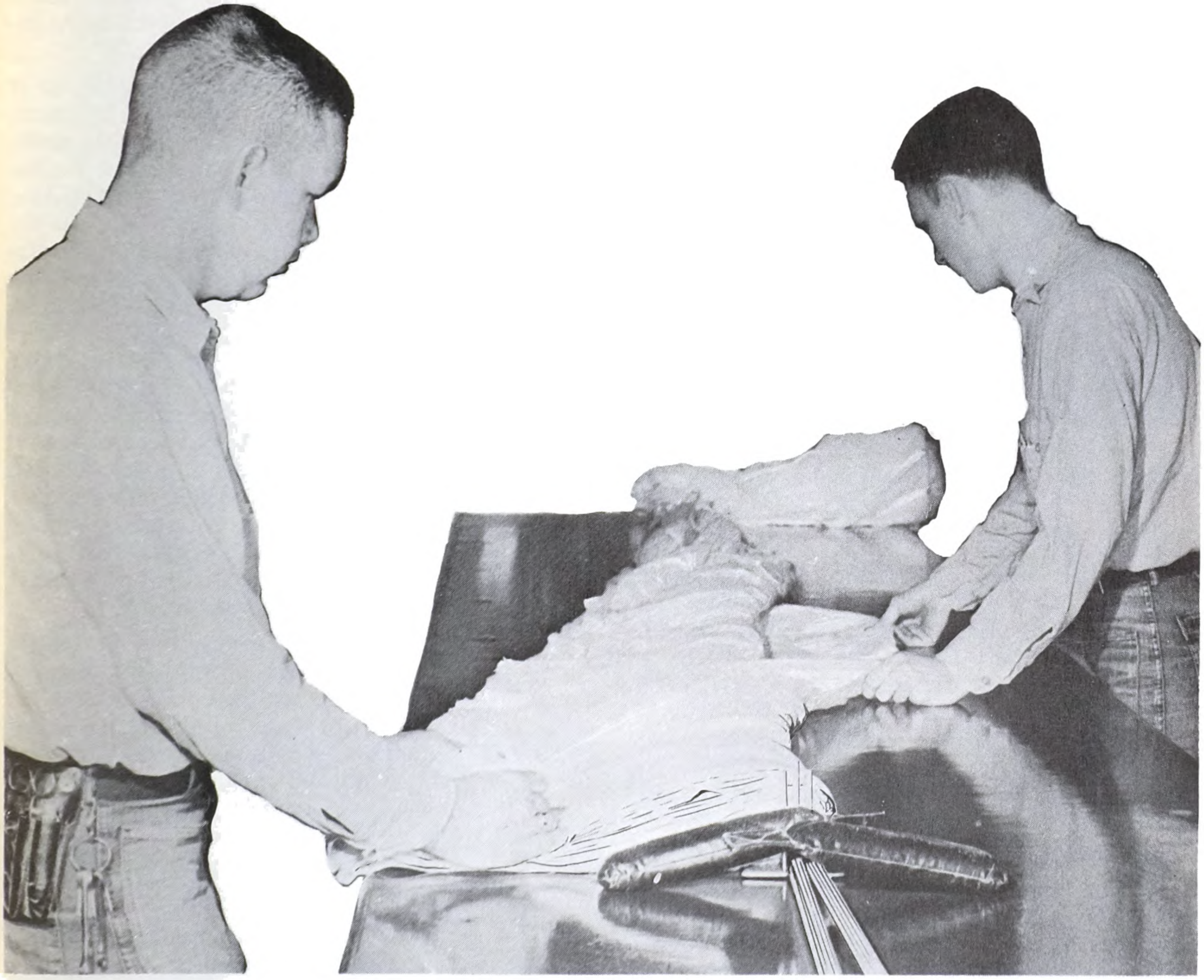


Figure 5-19.—Step III in completing the last two folds.

Keep an eye on the canopy to make certain that it is being drawn along in a straight line. The chest type parachute offers no stability problem on the table since there is no harness or para-raft container to tuck under the pack in an attempt to make an even working surface. Caution the helper, in holding the suspension lines, not to draw the bight beyond the position where you placed them. It takes practice on the part of the helper to hold, between his fingers, a bight of suspension lines perfectly in place and not lose one or exert a backward pressure in excess of the packer's hook tension. An experienced Rigger can quickly place a perfect group of suspension lines in a pack if he has a good helper.

Figure 5-28 illustrates the seventh bight of lines being drawn through the hesitator loop. Notice that there are no twists in the suspension lines and that they present a taut, straight appearance. The novice trying a hand at this operation has a tendency to twist the lines between the bights. This is brought about by not keeping the palm of the hand parallel to the table top when grasping and maneuvering the lines into the hesitator loops. Practice is the best way to bring about perfection.

Once the hook is engaged in drawing the lines through a hesitator loop, do not permit the tip to lose contact with the bottom of the pack. Experience will teach you the right amount of pressure to apply in drawing the lines through

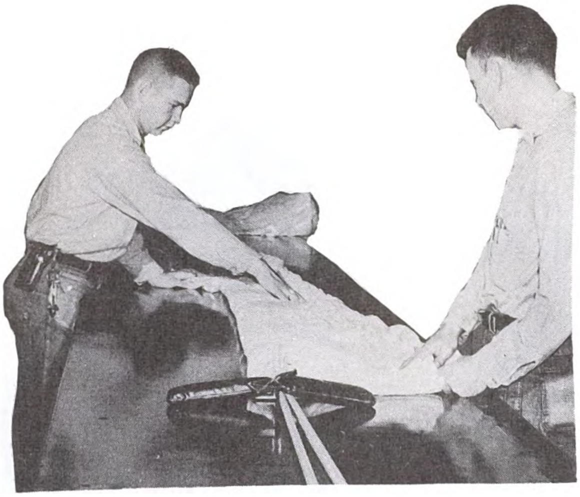


Figure 5-20.—Step IV in completing the last two folds.

the hesitator loops. No other single step in packing the parachute consumes the time that this does. After the last bight has been placed, check for dropped lines. Check the length of lines between the last bight and the skirt. There should be enough line left to permit the skirt to be brought up to the far edge of the pack, 12 to 18 inches is ideal. Too much length left over invites a ''line over'' condition when the parachute is jumped.

To correct a dropped line condition, pull the suspension lines out of the loops until you find all of the places where they have been dropped. This often results in starting over.

Straighten the hesitator loops with the hook or a temporary locking pin as illustrated in figure 5-29. Remove the tucks or wrinkles created by the action of drawing the tight fitting lines through the hesitator loops. If you do not iron out the wrinkles, they will take a permanent set, and the next time you attempt to draw the lines through a wrinkled hesitator loop it may tear out along the stitching.

The pack is now ready to receive the canopy. Withdraw the sides and ends of the pack that have been tucked out of the way. Turn the pack 90 degrees clockwise so that the suspension lines are in position, as illustrated in figure 5-30. The lift web protector flaps are also placed in position over the lift webs.

The suspension lines are arranged to come from the middle of the pack, and the helper holds the long bar over these lines in preparation for the canopy, as illustrated in figure 5-31. The first shot bag is removed, also the suspension line holder.

Grasp the skirt, lift, and bring it in a straight line toward the ripcord end of the pack. Stop when directly over the edge of the pack. Be careful not to disarrange the folds or the suspension lines in stowing the canopy. Caution the helper not to hold down or draw back on the long bar during this operation but to follow the motion of the lines. Holding down or drawing back will cause the skirt to tuck under and may pull the last bight of suspension lines out of the hesitator loop. Drawing back on the long bar may also cause the lines to stick out beyond the edge of the pack. Throughout the entire packing procedure, neatness cannot be overemphasized. Do not permit the last free length of suspension lines between the skirt and the last hesitator loop to become entangled in the lines already stowed or to project from the edge of the pack. Figure 5-32 illustrates the position of the skirt in relation to the edge of the pack.

When the helper is certain that the skirt is in position at the edge of the pack and the suspension lines have not been disturbed, he withdraws the long bar and places it on top of the folded canopy in preparation for the next fold. The packer checks the long bar position for alignment. The bar is held to produce a clean fold over the edge of the frame. If the bar is held out too far from the edge, the fold will be too long. The position of the long bar is important to the neatness of the completed pack. The helper uses his left hand to steady the skirt end at the same time that the first fold is made. (See fig. 5-33.)

Hold the skirt lightly in place (figure 5-33), taking care not to disarrange the alignment of the skirt hem folds. THE SKIRT HEM IS BULKY. The first fold is brought up to a position just behind the skirt as illustrated in figure 5-34.

The receded fold, immediately behind the skirt edge, provides a reasonably flat surface for the others. As the canopy is folded onto the pack, time is taken to draw the material slightly beyond all edges of the pack for a distance of approximately two inches. This will assure a tight pack when the sides and ends are closed. The packer should give particular attention to the corners. If the corners are not properly filled out with the canopy, they will be soft and will not hold the corner flaps in place. A loose corner of the pack will permit the fabric of the

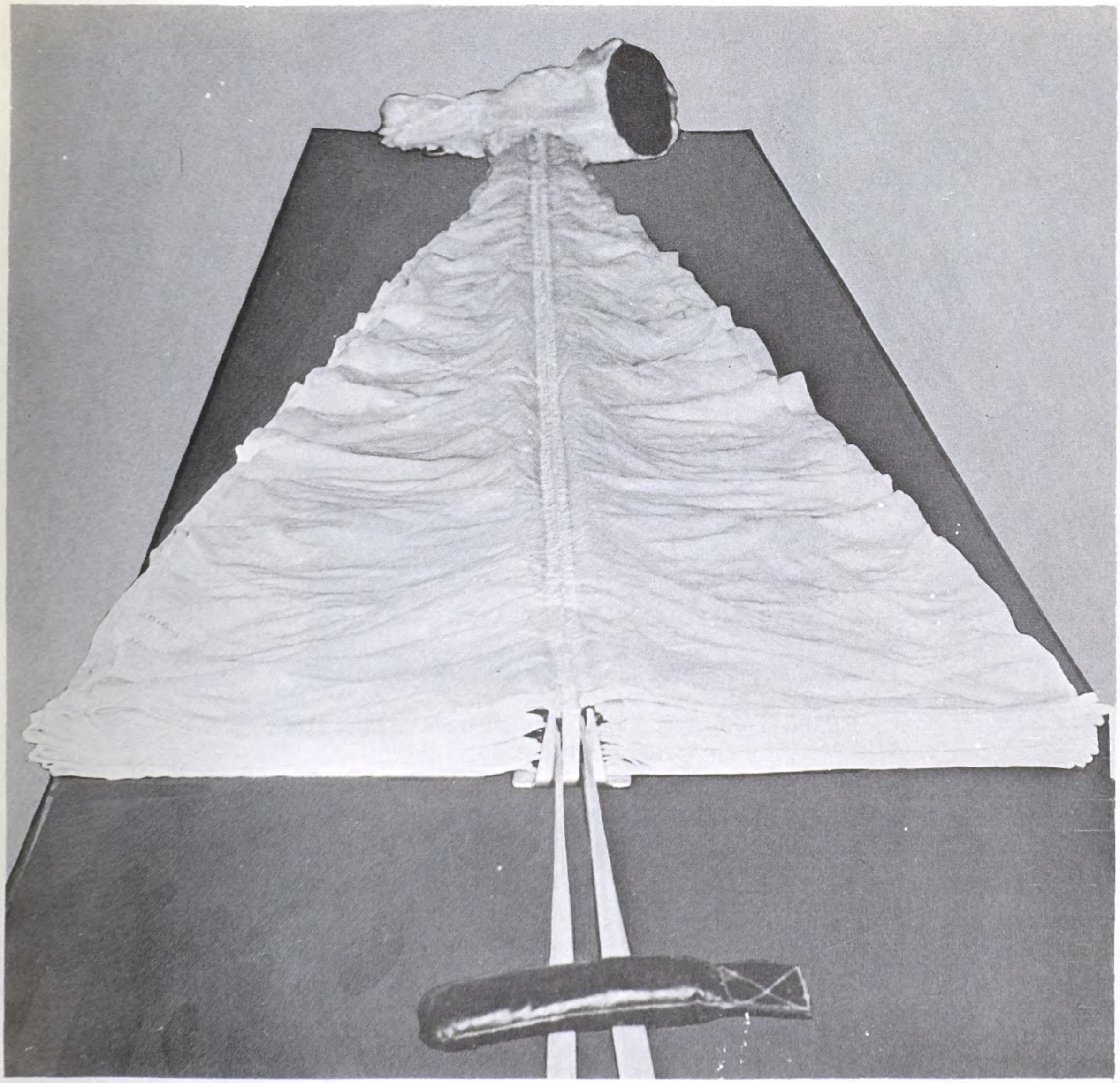


Figure 5-21.—All whipped folds completed.

canopy to protrude and become damaged or soiled.

Make certain that the shot bags are removed from the canopy before attempting to make the fold. Always take stock of the tools and equipment as you progress.

Bring up the next fold and position it. (See fig. 5-35.)

Another fold is made, and then the packer lifts the pilot chute off the peak and the last fold is cast, turning the peak under. (See fig. 5-36.)

Turn the pack 90 degrees to the left and prepare to place and compress the vane type pilot chute directly on top of last fold.

Fake or coil the connector webbing on top of the canopy as the helper prevents the canopy from slipping. Position the pilot chute directly in the center of the pack and compress it while guiding the spring in as straight a pattern as possible. Do not tuck the material of the pilot chute canopy under or around the springs as it is compressed. (See fig. 5-37.)

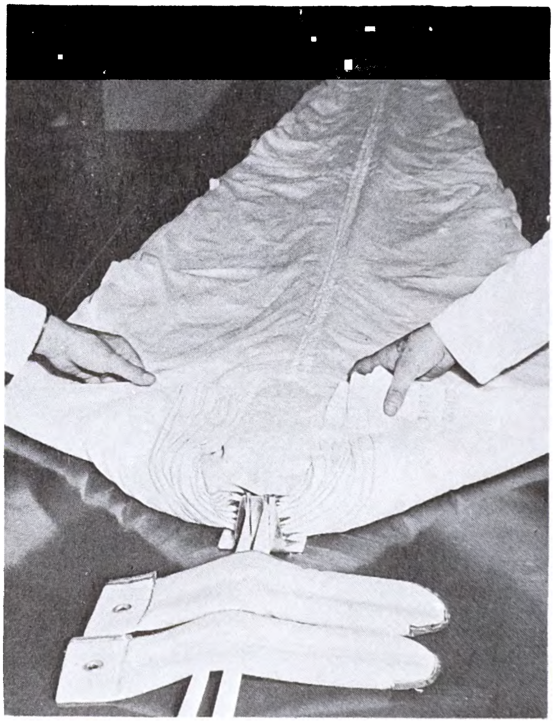


Figure 5-22.—(A) Skirt folded back preparatory to straightening.

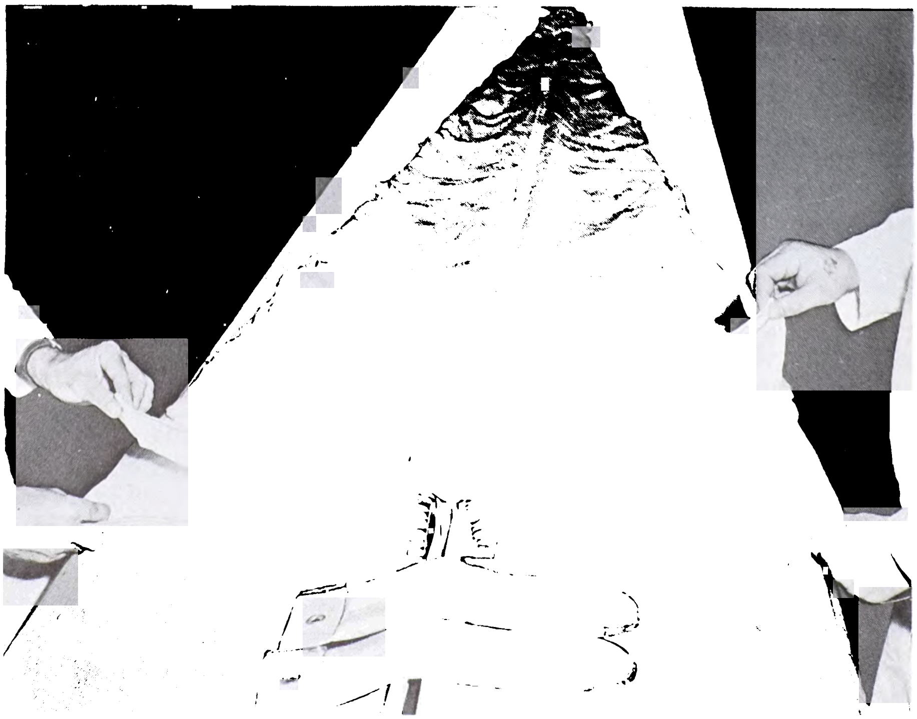


Figure 5-22.—(B) Straightening skirt.

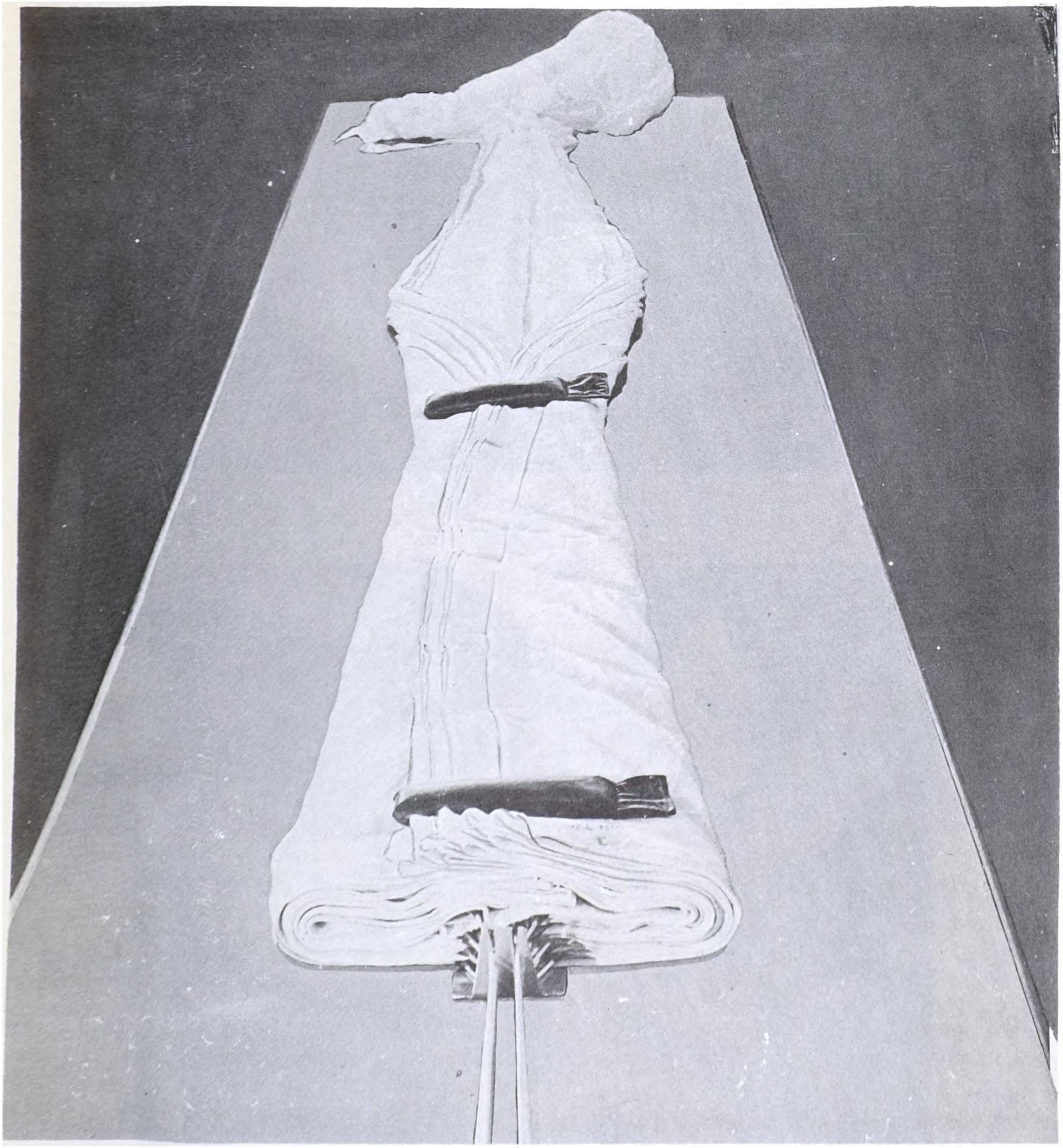


Figure 5-23.—Canopy folded in thirds and held in place by shot bags.

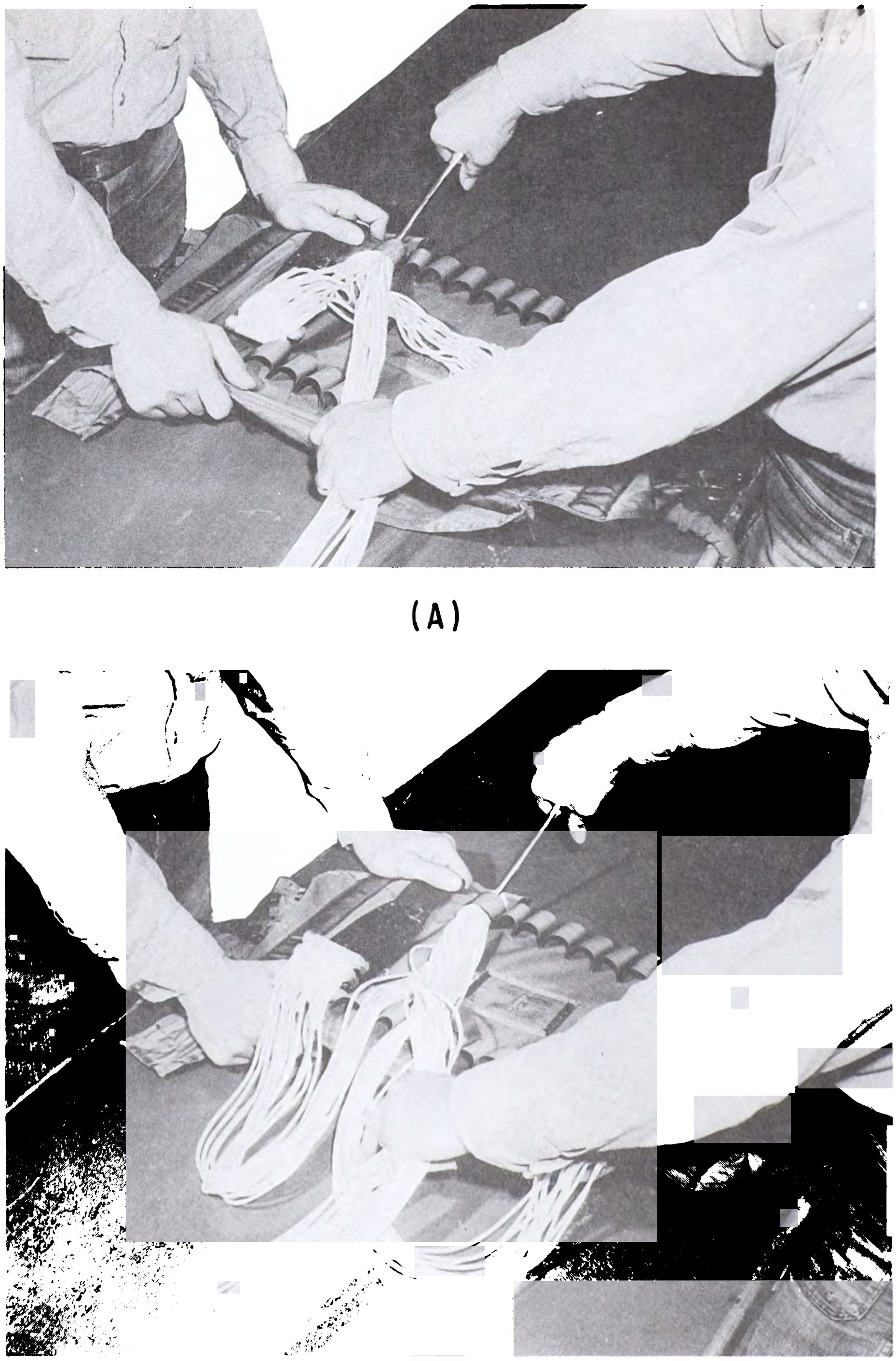


Figure 5-24.—Common errors in stowing suspension lines.

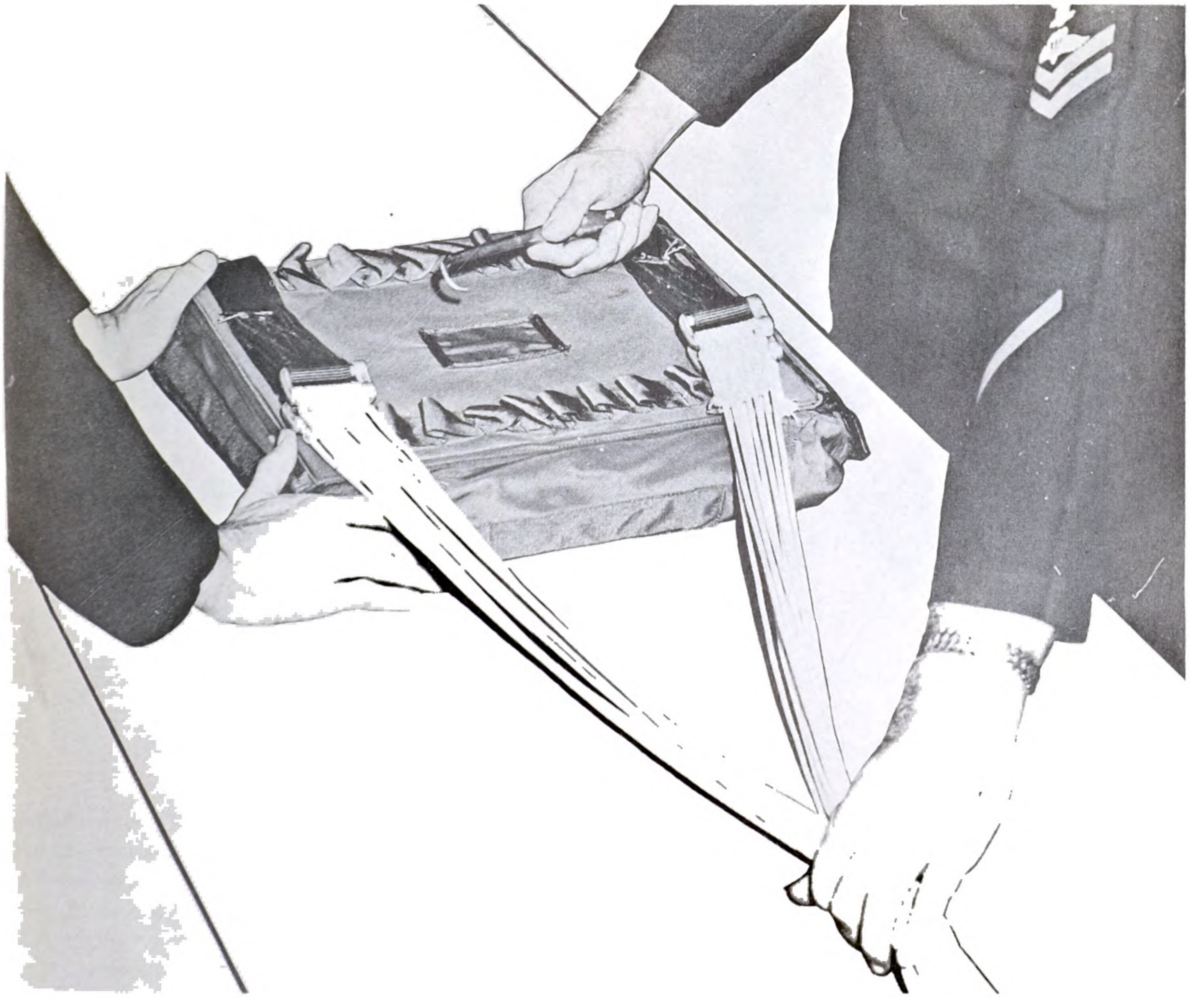


Figure 5-25.—Stowing suspension lines; gaging length (22 to 23 inches).

The packing team holds the pilot chute compressed with their forearms and together grasp the pilot chute protector flap attached to the locking cone side of the pack. (See fig. 5-38.)

As the side is drawn up, prevent the fabric of the canopy from bunching toward the center. Keep it smoothed down by working your free hand between the side flap and canopy. Once the side has been drawn into position, shift around and prepare to pull up the other side while holding the first in place. (See fig. 5-39.)

Still grasping the pilot chute protector flap attached to the grommet side of the pack, draw the side up to position while keeping the canopy smoothed in place. The grip is shifted, pressure is brought to bear on the assembly, the locking cones are brought into position, the grommets are passed over the cones, and the temporary pins are inserted in the cones. (Note the way the pins are inserted.) The major part of the closing operation is completed. (See fig. 5-40.)

Straighten the folds and corners of the canopy. Work the excess fabric back into the center portion of the canopy. Remember the corners, paying particular attention to them.

Do not pound on the pack. The end flaps can be worked into position without too much effort. If the end tab will not reach, straighten and shift the canopy, but not excessively. Do not let the helper push the canopy out the end of the pack when he brings up the end flap.

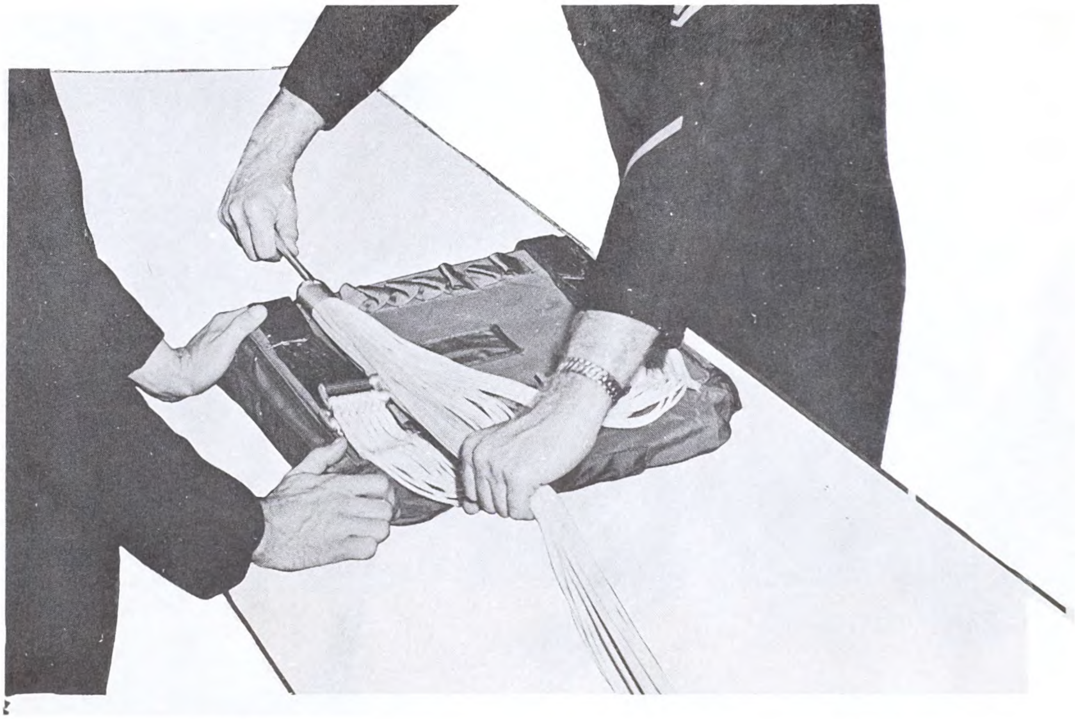


Figure 5-26.—Stowing suspension lines; drawing first bight.

Many of the operations call for joint action by both members of the packing team. In order to accomplish these steps smoothly, practice is required.

The packer inserts his fingers in the end flap pockets while his helper makes some last minute adjustments to the folds and straightens the lift web protector flap. Grasping the end flap in one hand, the helper pulls it up and over in the direction of the corresponding locking cone while the packer shifts his hands to the outside and exerts pressure to compress the assembly. (See fig. 5-41.)

When the end tab has been brought into position above the locking cone, the assembly must be held closed while the temporary pin holding the side flaps together is removed. The end tab can now be placed down over the cone passing below the ripcord pin hole, and the temporary pin reinserted to hold the side flaps and one end flap together for further packing operations. After gaining experience in closing this end, you may prefer inserting the ripcord and using the ripcord pin, thus eliminating the necessity for two withdrawals of the temporary pin. (See fig. 5-42.)

If the vane type pilot chute has shifted and is not centrally located, you may experience trouble in getting the locking cone passed through the hole in the end tab. This is due to the locking cone tilting down and back on the protruding section of the pilot chute spring. The vane type pilot chute should be held in a central position after it has been placed on the canopy and through all subsequent steps until the pack is secured with the ripcord pins. If this uneven condition still exists after the pilot chute has been checked and found to be centralized, there is an indication that the spring is bent or compressed out of line. The remedy for this, of course, is to renew the pilot chute or improve the manner in which you compress the spring.

When exerting pressure on the pack during these closing steps, remember: DO NOT DISARRANGE THE STEPS TAKEN EARLIER IN THE PACKING PROCESS. Exert every effort to improve your technique so that every step from the first to the last can be done smoothly. As a Parachute Rigger, it is your responsibility to make every pack perfect.

The helper inserts his fingers in the end flap pockets while the packer makes last minute adjustments to the end folds of the canopy and

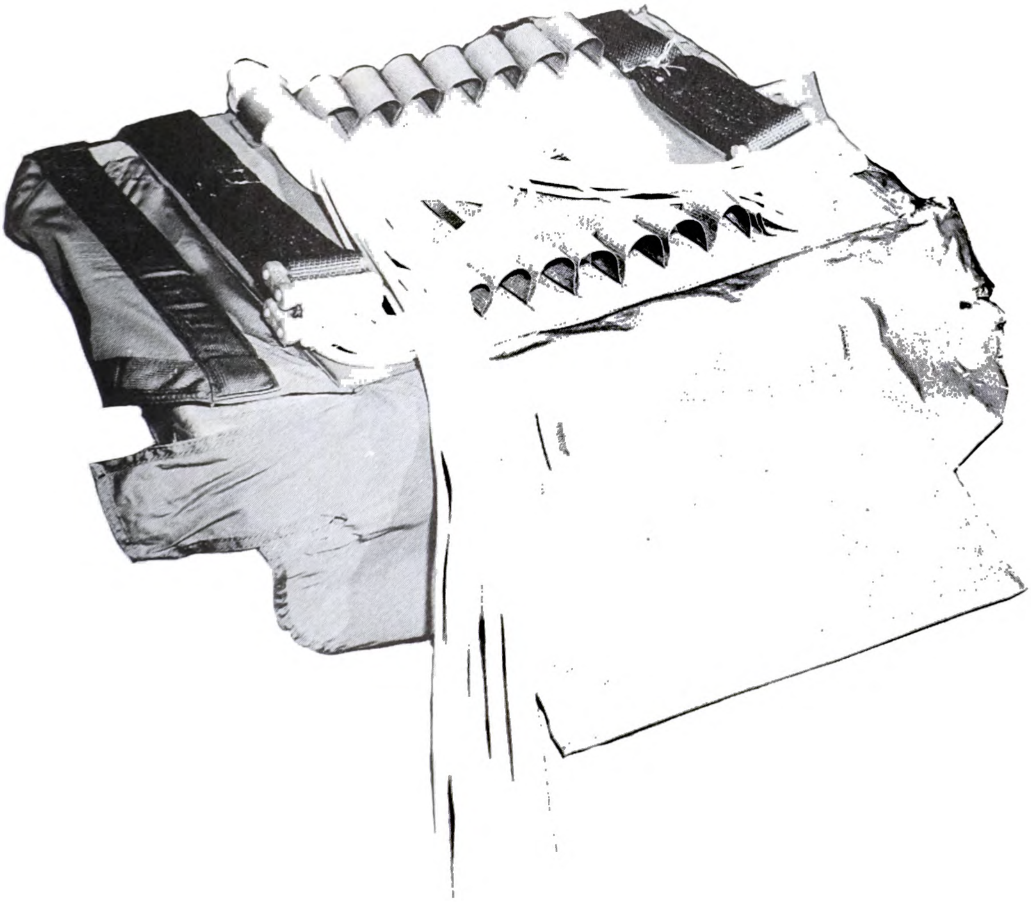


Figure 5-27.—Arrangement of suspension lines.

straightens the lift web protector flap. As the helper applies pressure to compress the pack, the end flap is brought into place. The temporary pin is pulled out of the appropriate locking cone and reinserted after the end tab has passed over the cone and everything else is held securely together. The second pin of the ripcord **could have been inserted instead of the temporary pin providing, of course, that the ripcord had been used in the beginning.** Figure 5-43 illus**trates the completion of the closing operation. Temporary pins hold the pack closed prior to straightening.**

The long bar is again brought into play. Figure 5-44 illustrates its use in straightening the ends of the pack.

A long bar will not work the side flap ends toward the center of the pack. A fid is used to complete the straightening of the pack. Figure 5-45 illustrates the uses of the fid.

If not previously inserted, the ripcord may at this time be inserted. (See fig. 5-46.)

There are many experienced Parachute Riggers who prefer to engage the ripcord at this time because of the ease in which it passes through the locking cones of a smoothed pack. There is a danger of missing the cones and having to go through the straightening process again, but the experience gained with this method holds such a possibility to a minimum.

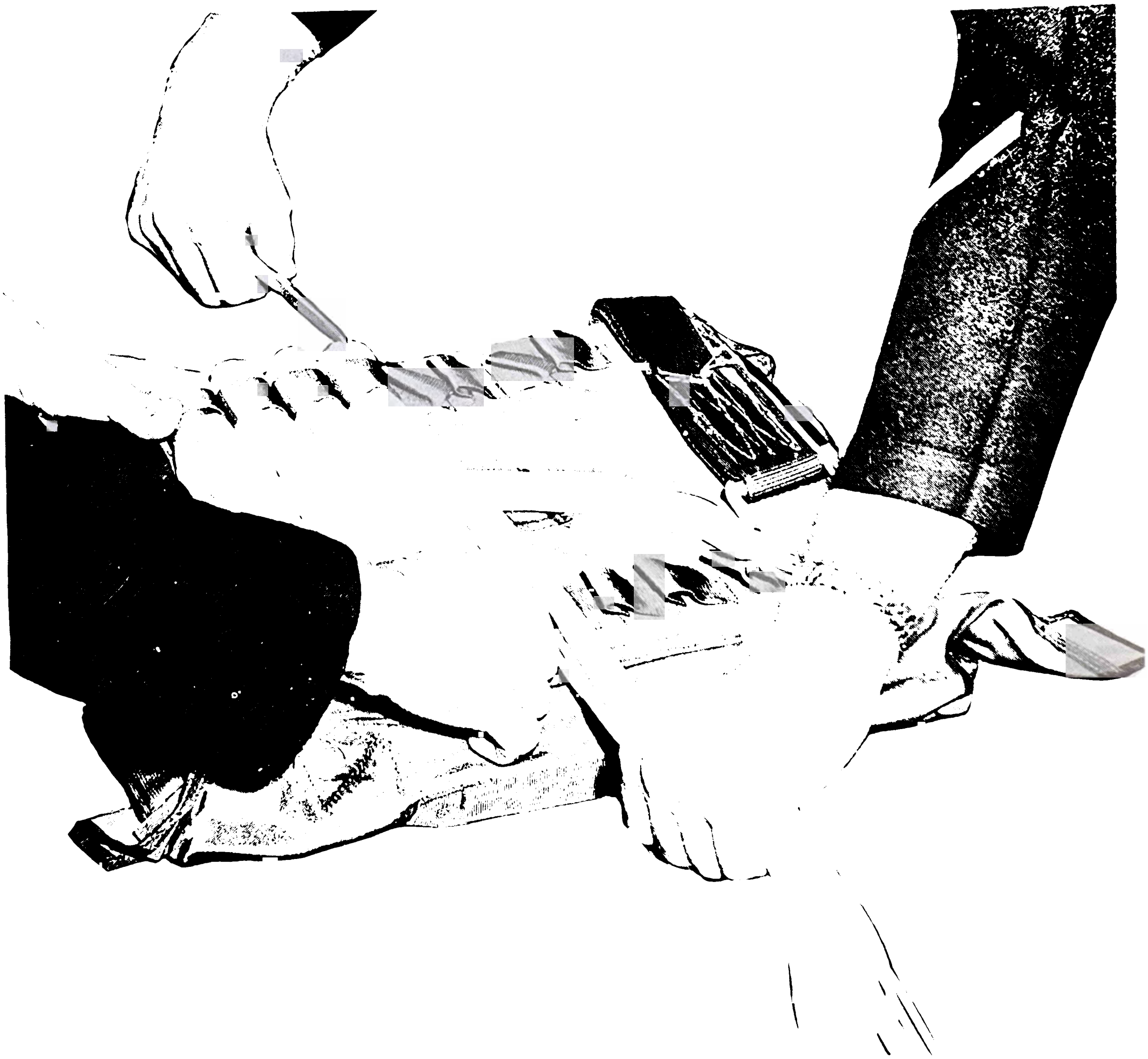


Figure 5-28.—Stowing suspension lines; seventh bight.

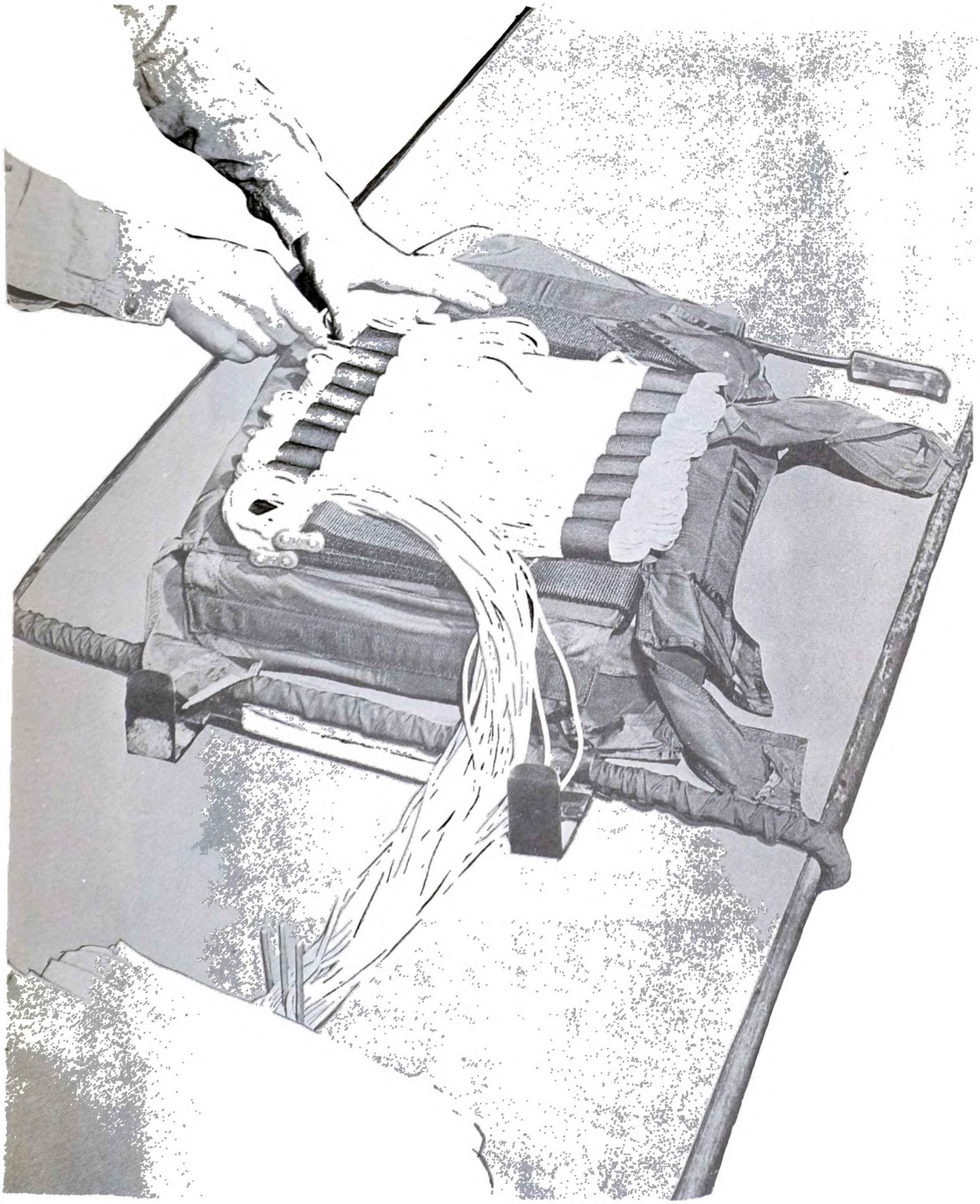


Figure 5-29.—Straightening the hesitator loops.

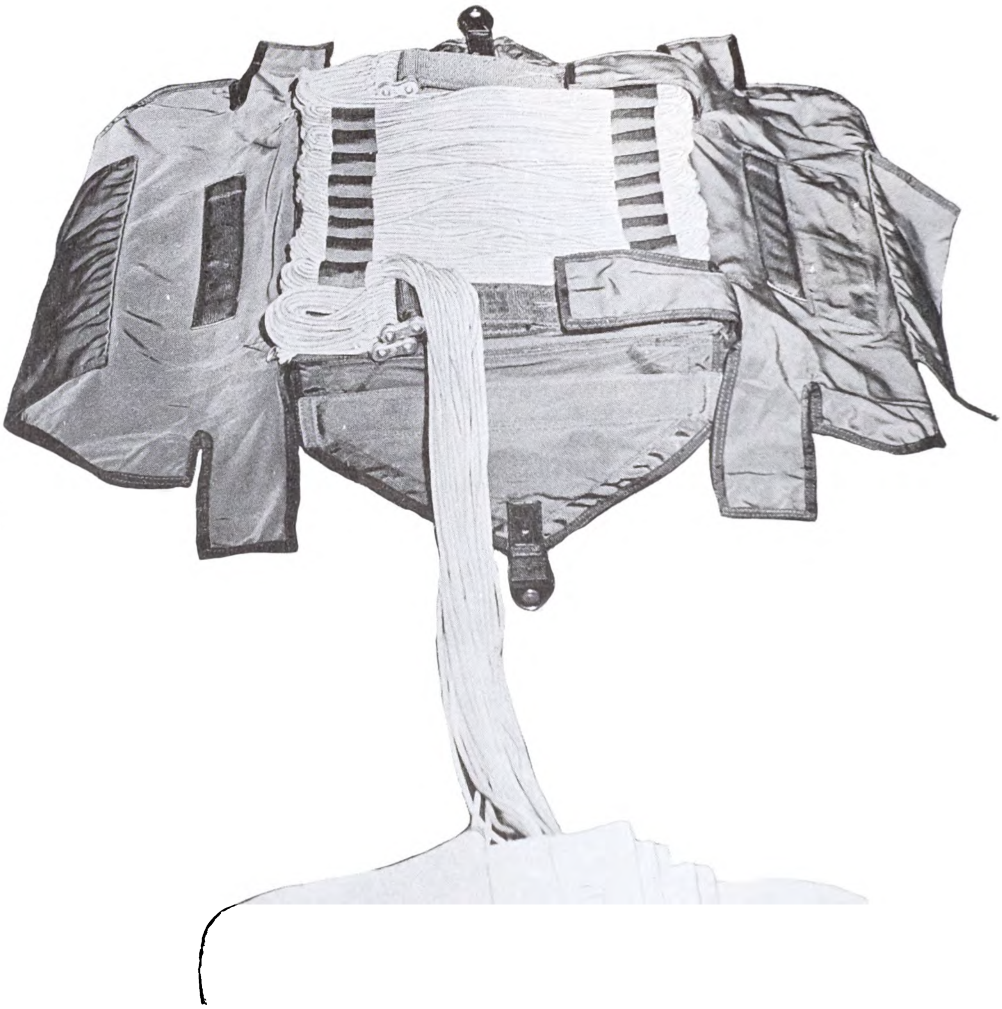


Figure 5-30.—Pack turned and ready to receive canopy.

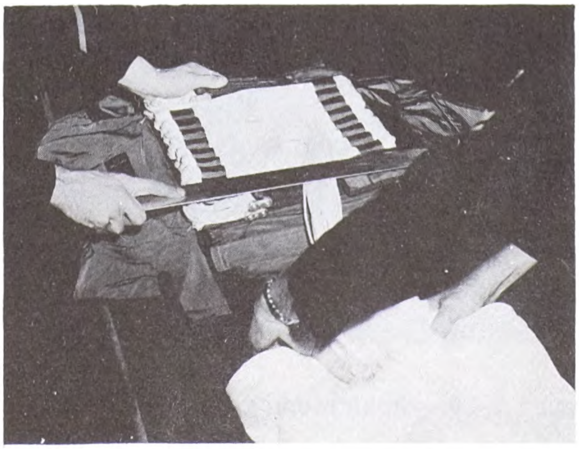


Figure 5-31.—Long bar in place; canopy ready to be lifted on pack.

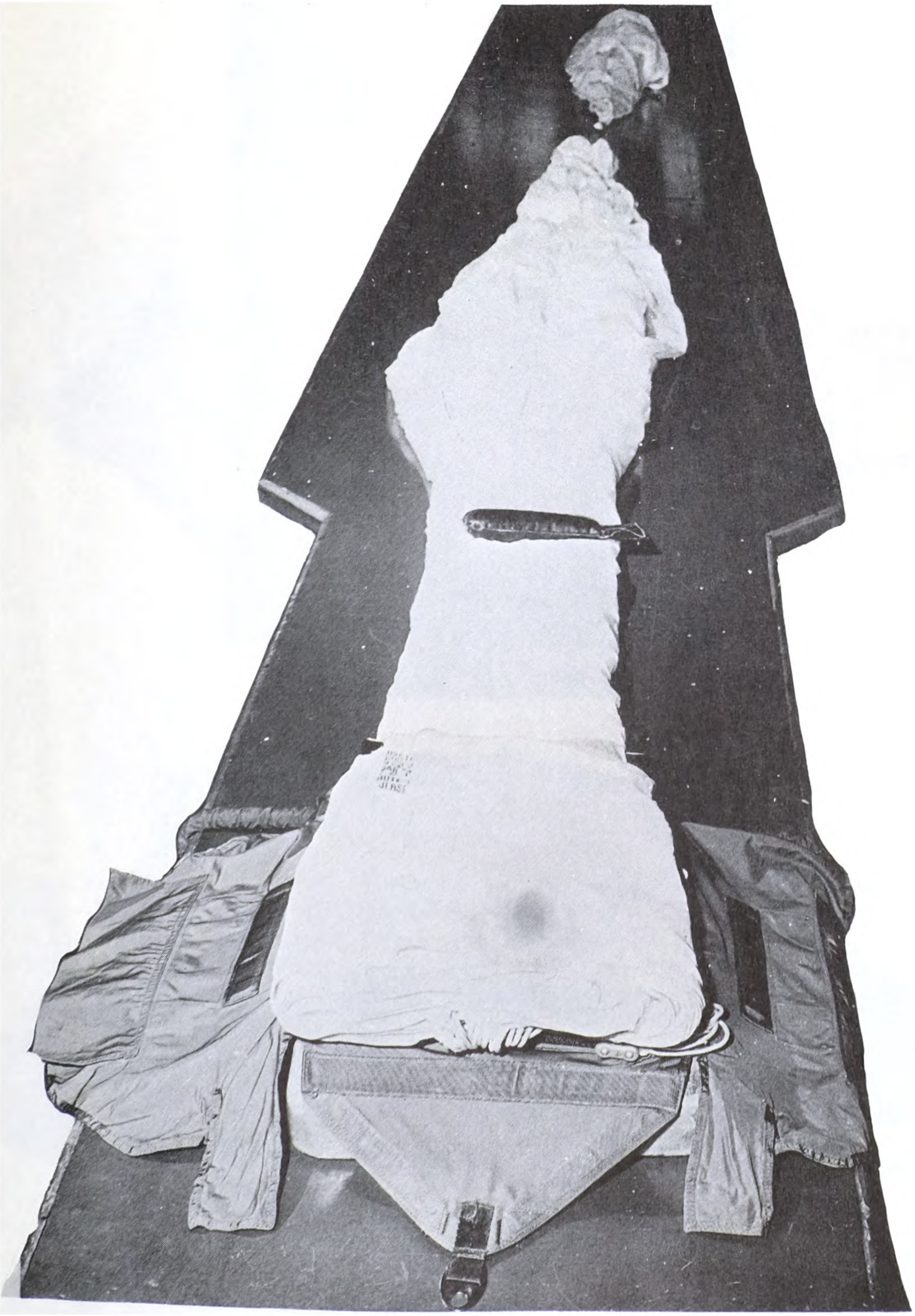


Figure 5-32.—First section of the canopy placed on the pack.

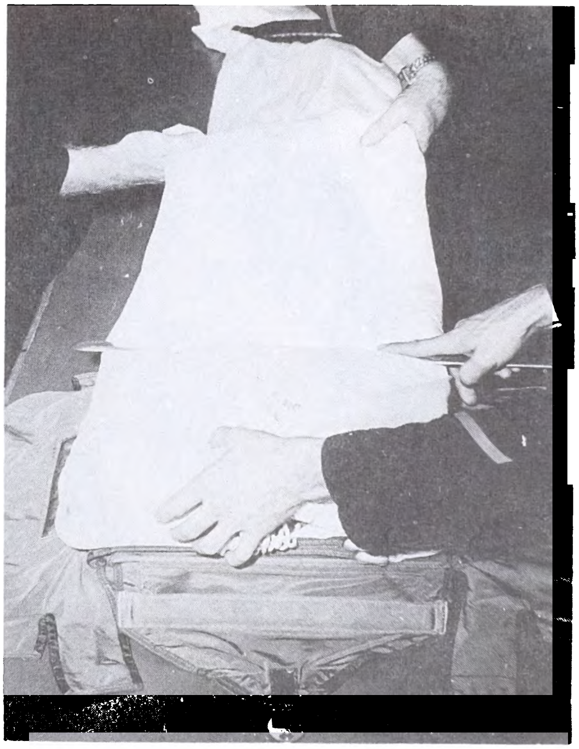


Figure 5-33.—First fold coming up.

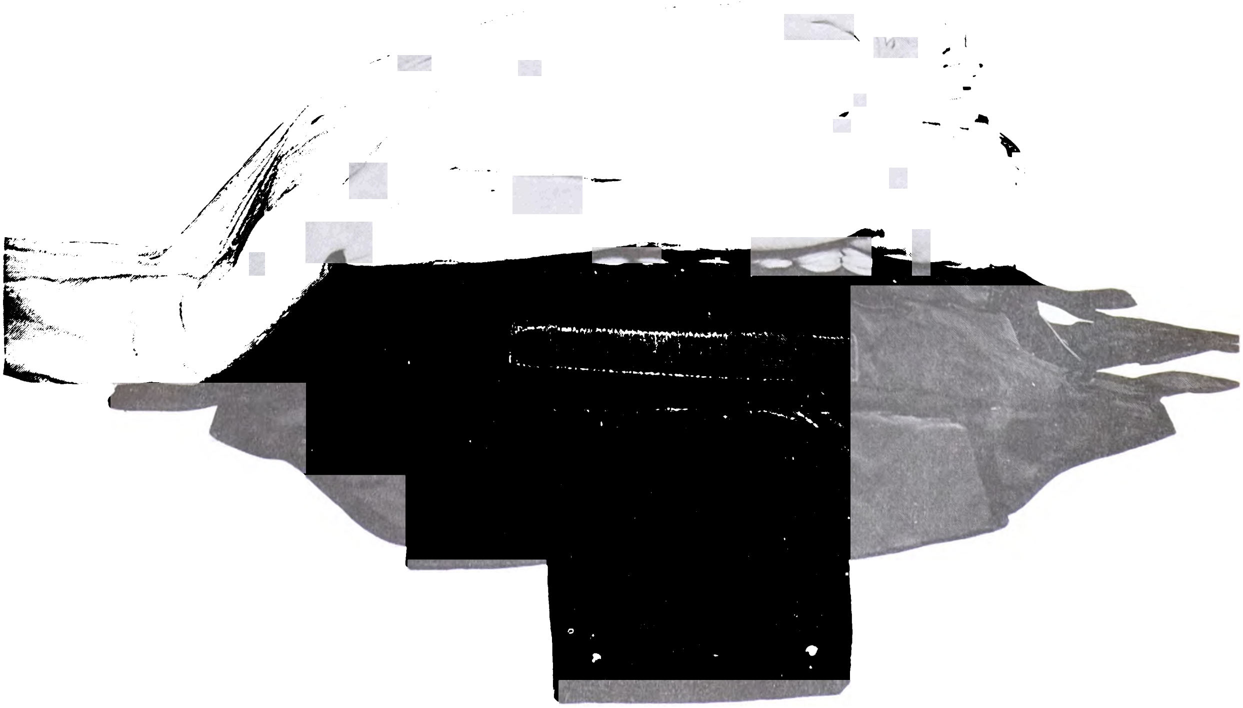


Figure 5-34.—First forward fold placed immediately behind skirt.

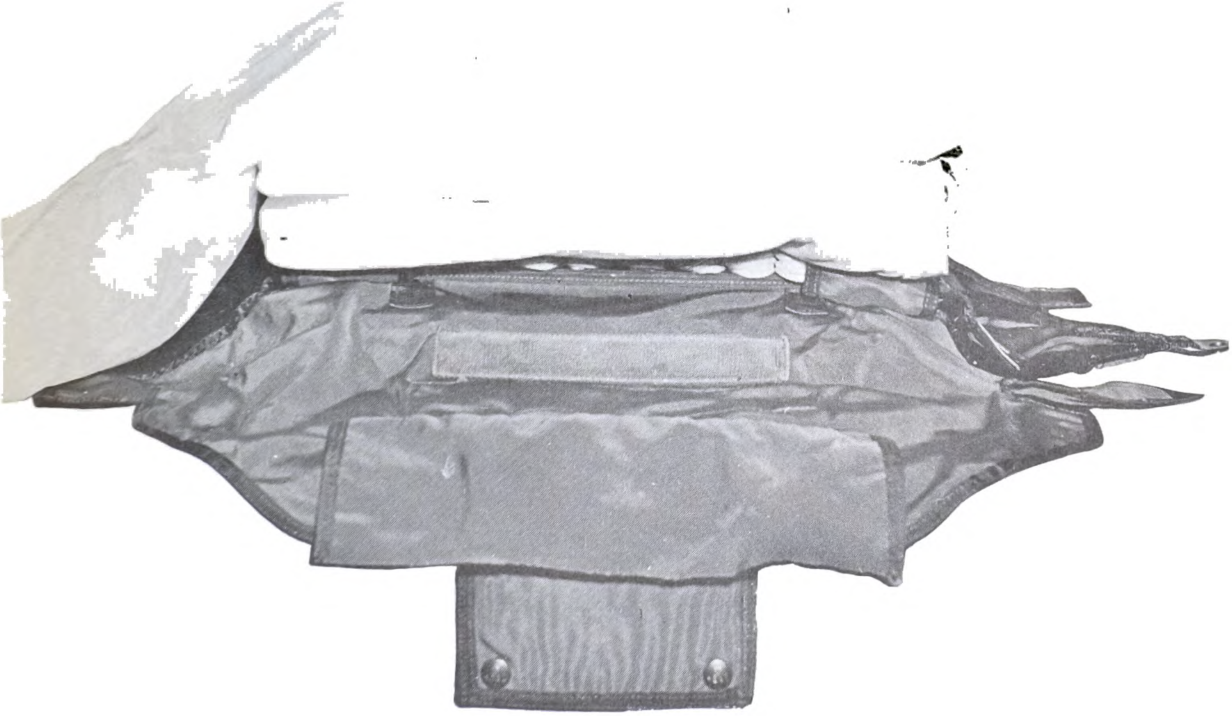


Figure 5-35.—Next fold in place directly over skirt hem.

Safety tie the ripcord pins with nylon thread size A. Figure 5-47 illustrates the method of safety tying the ripcord locking pins. The important thing to remember in a safety tie is that it prevents the ripcord locking pins from working out of the cones. A stronger thread or cord would exceed the recommended tensile strength and is therefore dangerous to use.

Generally speaking, a thread having a tensile strength between three and five pounds may be used for a safety tie. The compressed bulk of the canopy exerts enough pressure on the sides and ends of the pack to hold the pins in place. The addition of a safety tie tends to prevent, to a certain extent, a premature opening.

Hook up the opening bands. Make certain that the opening bands are free from twists and are properly fastened to the securing eyes of the pack. You will not have any difficulty in arranging the opening bands of this parachute since everything is right out in the open. There are no seat cushions or harness slings with which to cope. Figure 5-48 illustrates the correct passages for the opening bands.

The chest type parachute assembly is rigged so the container will break away with the lift web tackings. The bands pass UNDER the cross connector strap. Follow figure 5-48 carefully.

Make tests and adjustments.

Sign the Parachute Record Card. Do not print your name. The man inspecting and packing the parachute is responsible for signing the Parachute Record Card. His signature is a sign of approval and a guarantee that the parachute will WORK. A corresponding entry on the Parachute History Card is also made. (See fig. 5-49.)

Fold the card and insert in the pocket provided on the pack. Check the pocket on the cross connector strap for an Emergency Signal Code. This form illustrates certain signals to be observed in aiding the individual's rescue.

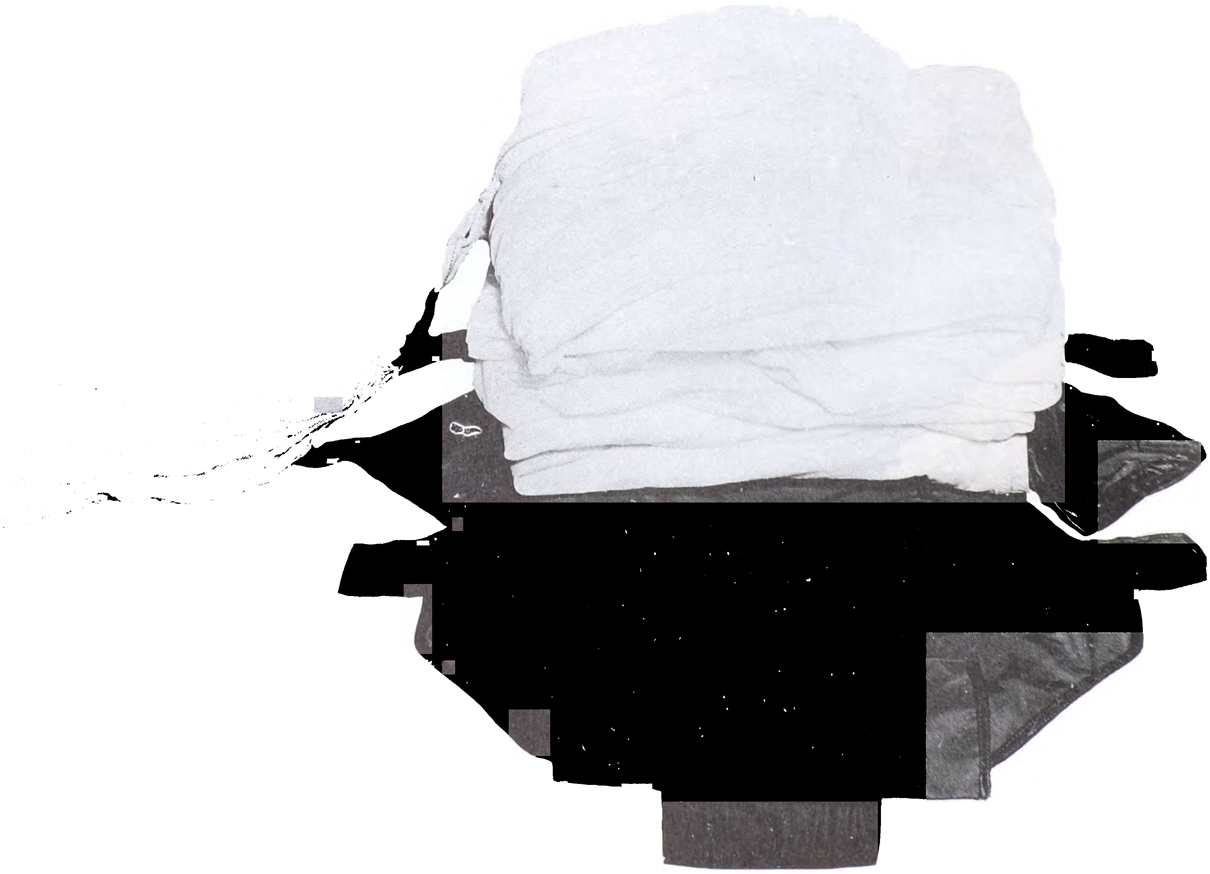


Figure 5-36.—Last fold; peak turned under; pilot chute connector webbing running straight aft on top.

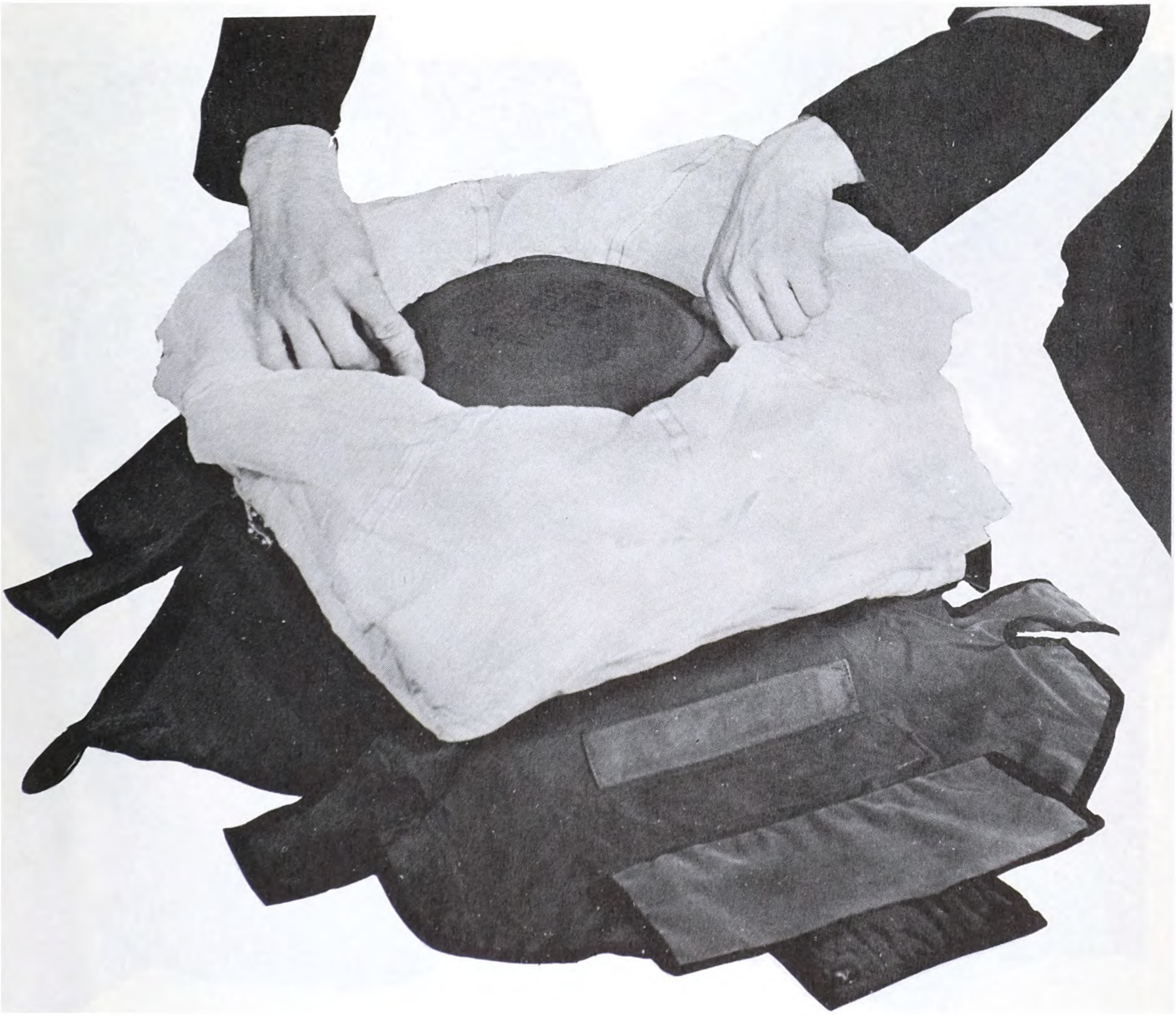


Figure 5-37.—Pack in position to receive vane type pilot chute.

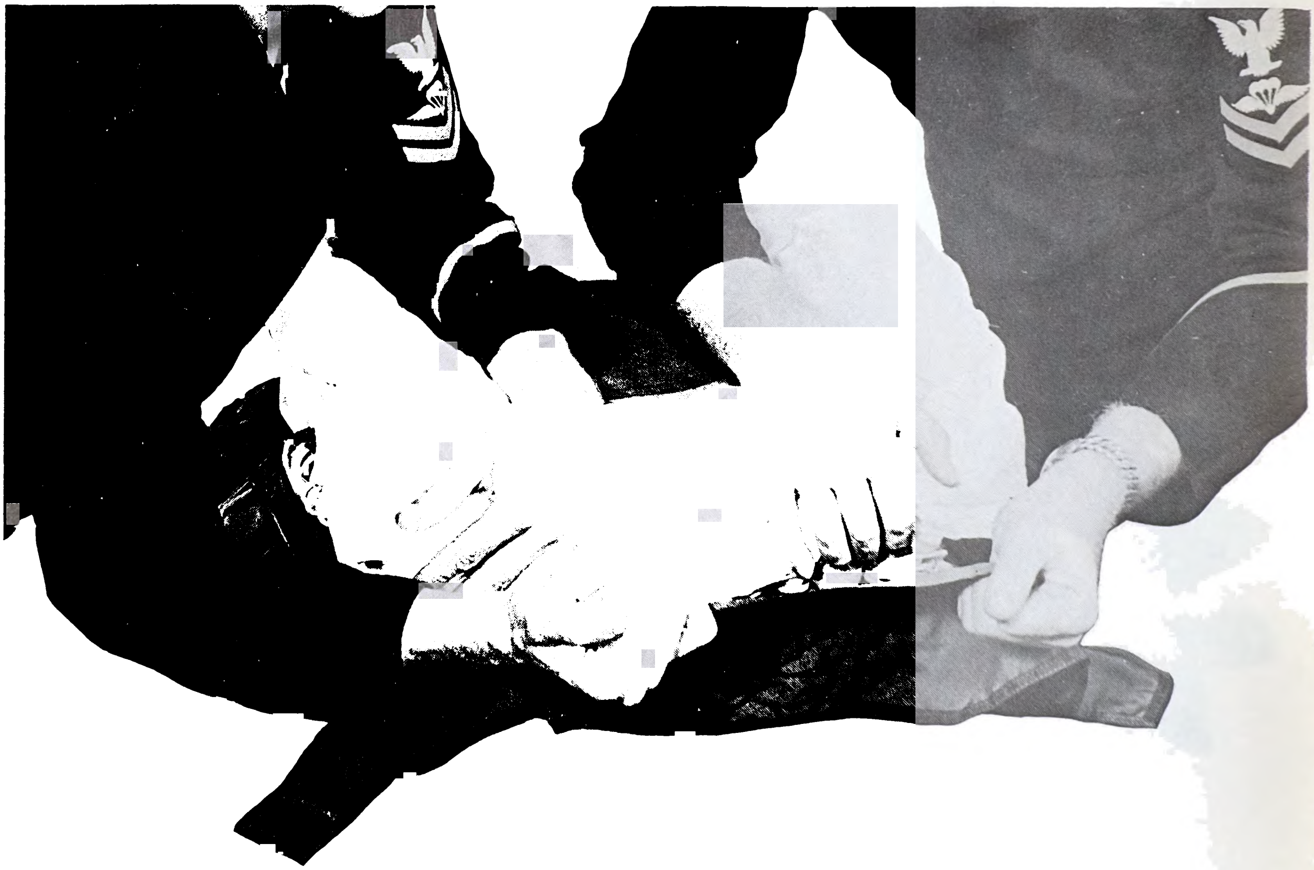


Figure 5-38.—Ready to draw up first side.

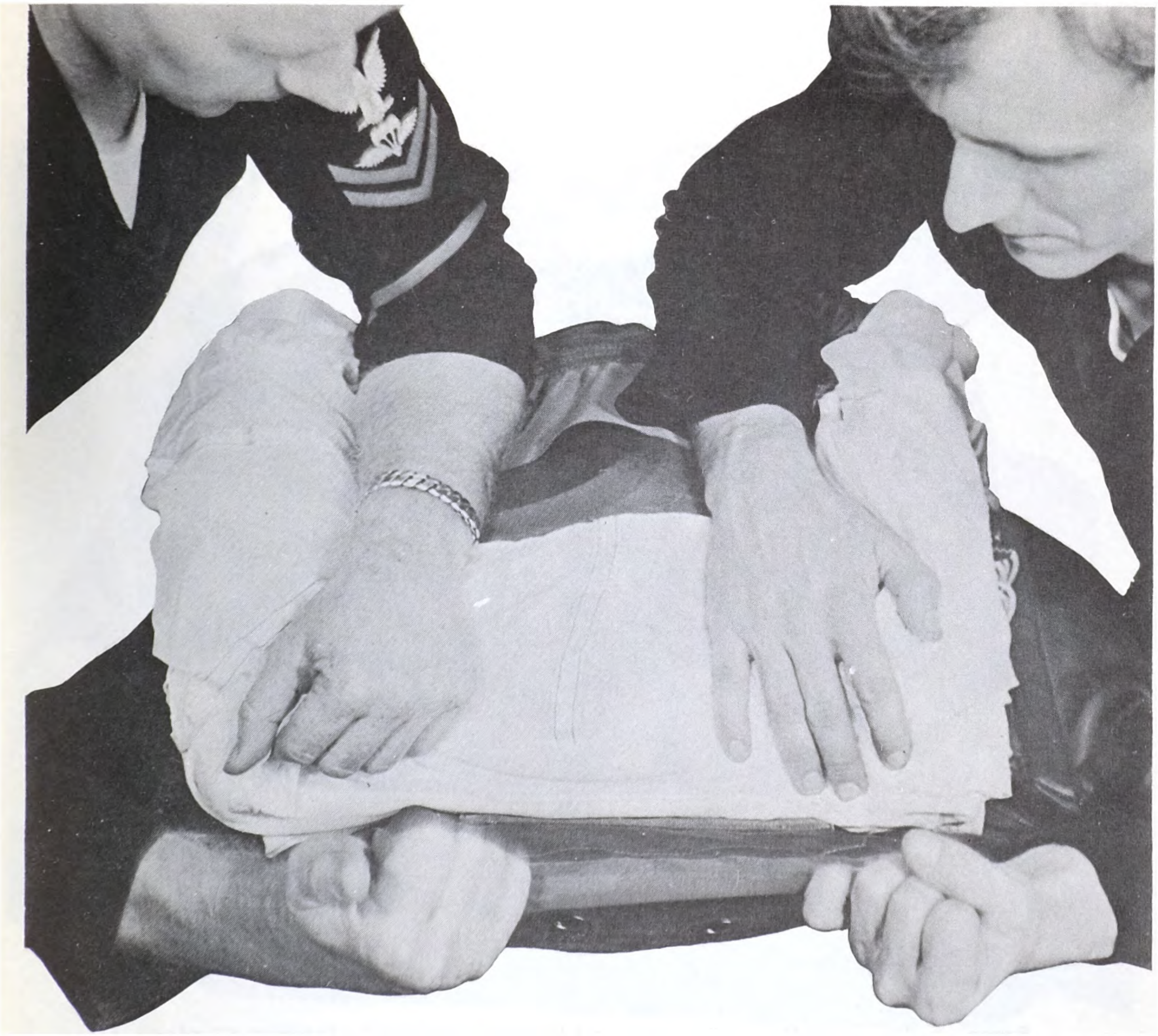


Figure 5-39.—Ready to draw second side closed.

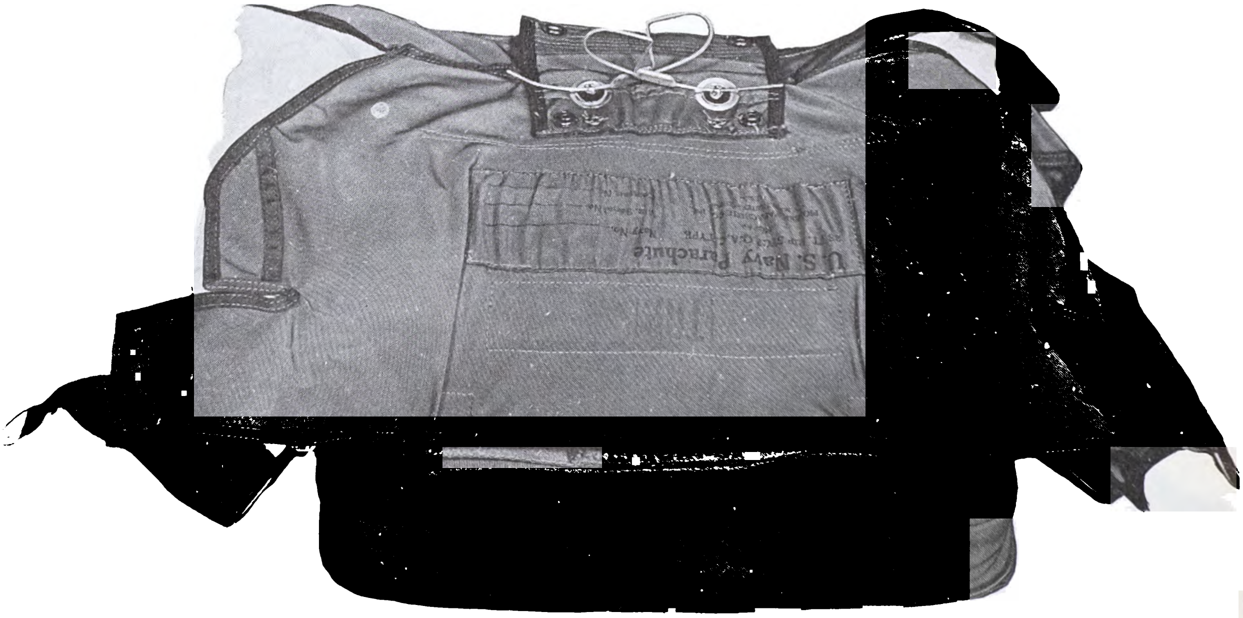


Figure 5-40.—Side flaps drawn up and held in position by temporary pins.

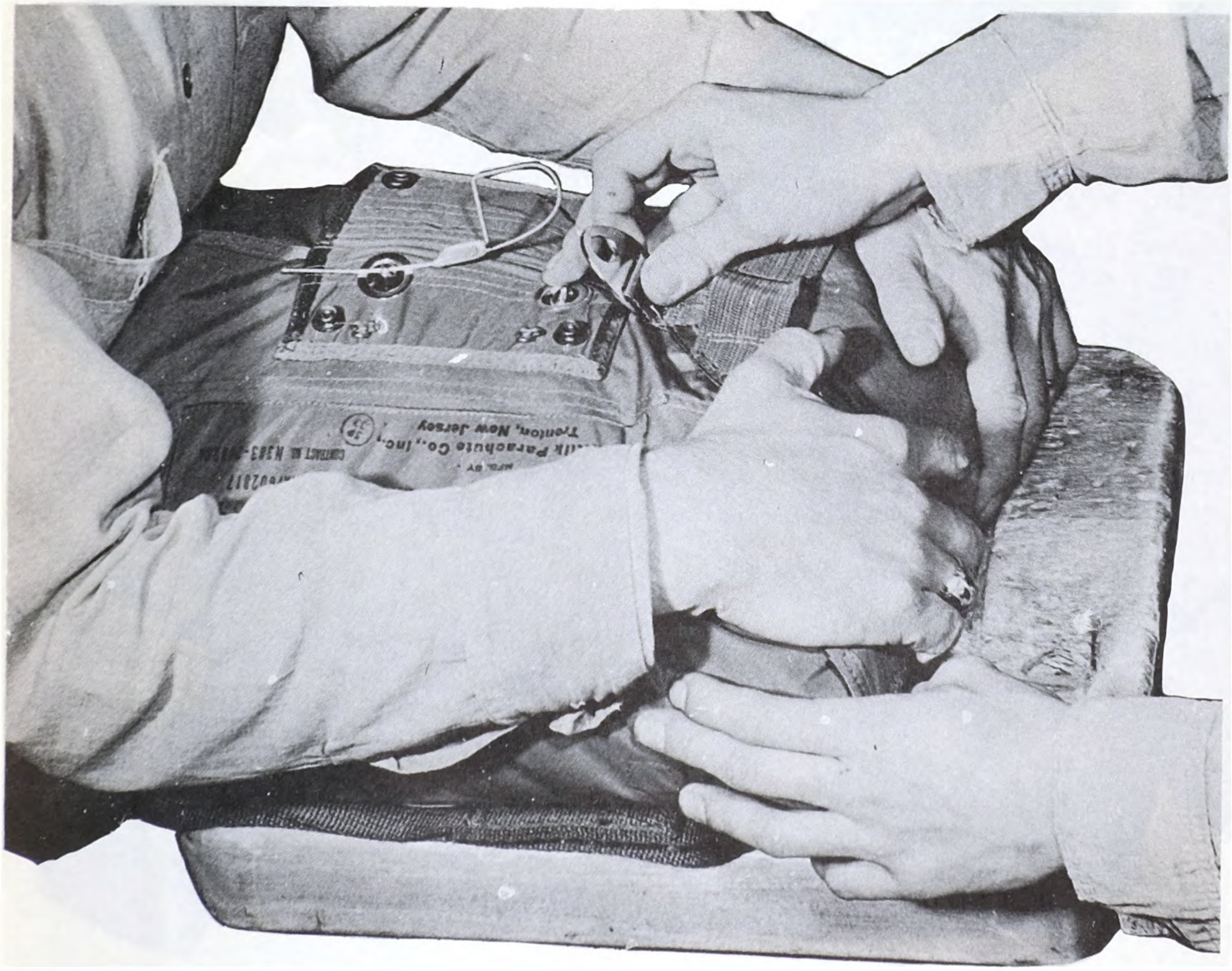


Figure 5-41.—Closing first end flap.

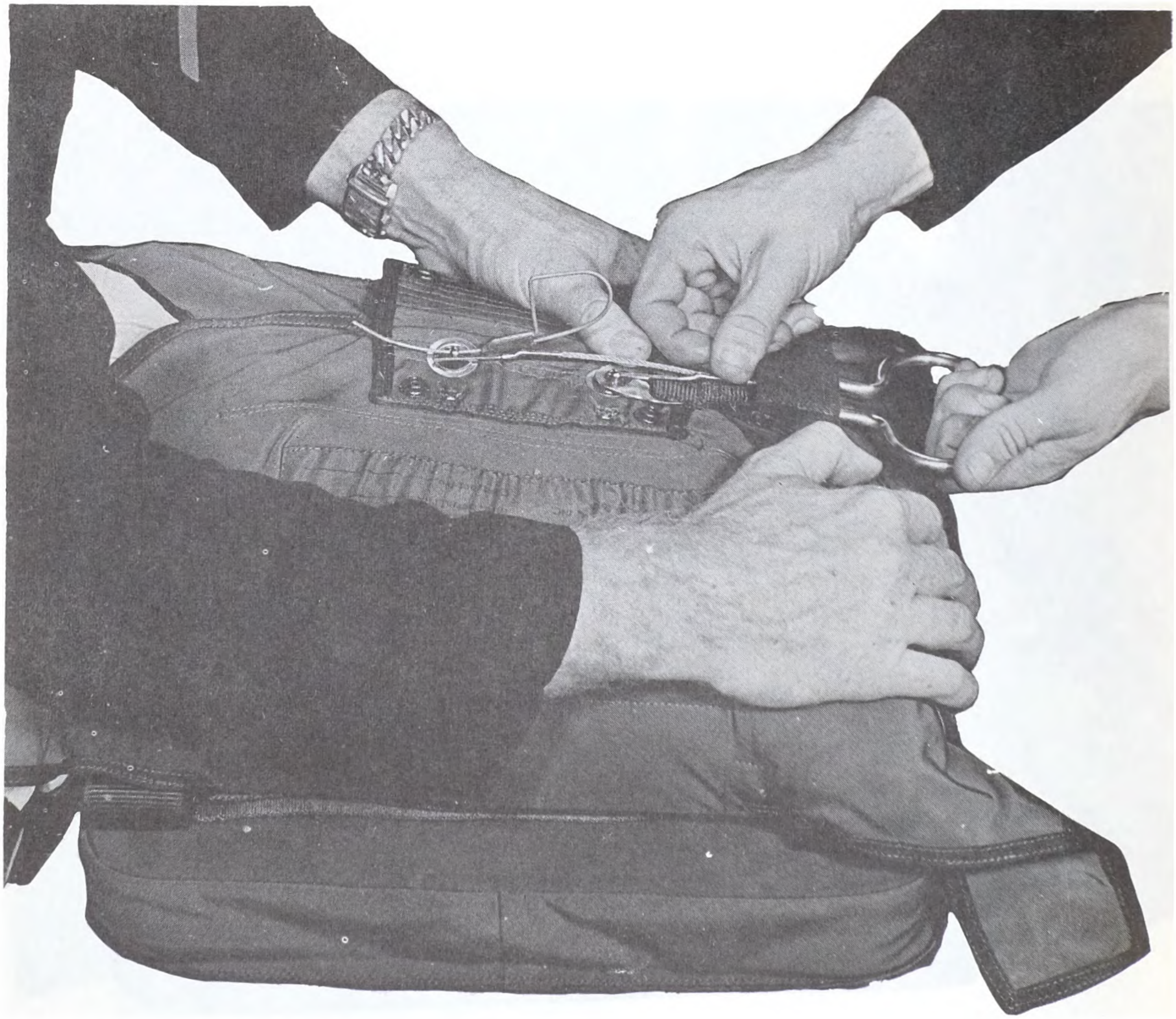


Figure 5-42.—Closing the first end flap and securing the assembly with the ripcord pin.

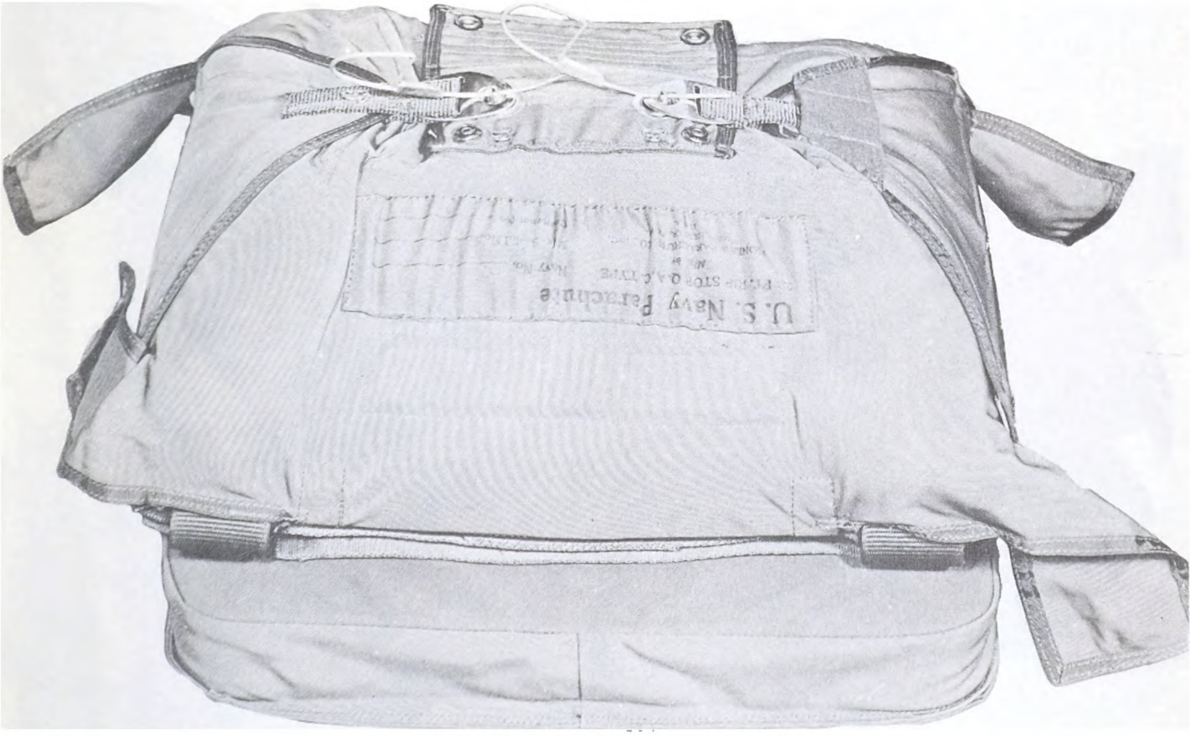
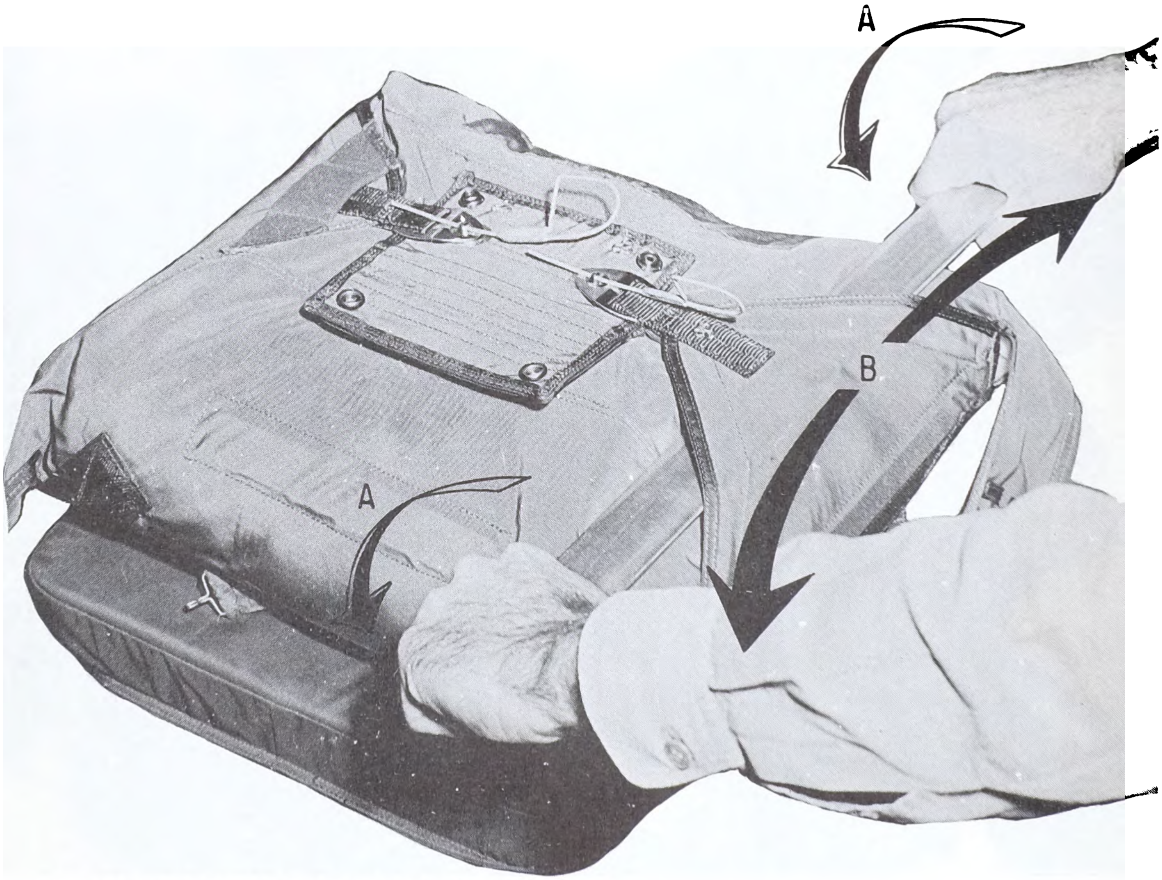


Figure 5-43.—Sides and ends closed and ready for straightening.



A. ARROWS INDICATE ROLLING MOTION
B. ARROWS INDICATE ROCKING MOTION

Figure 5-44.—Using long bar to straighten pack.

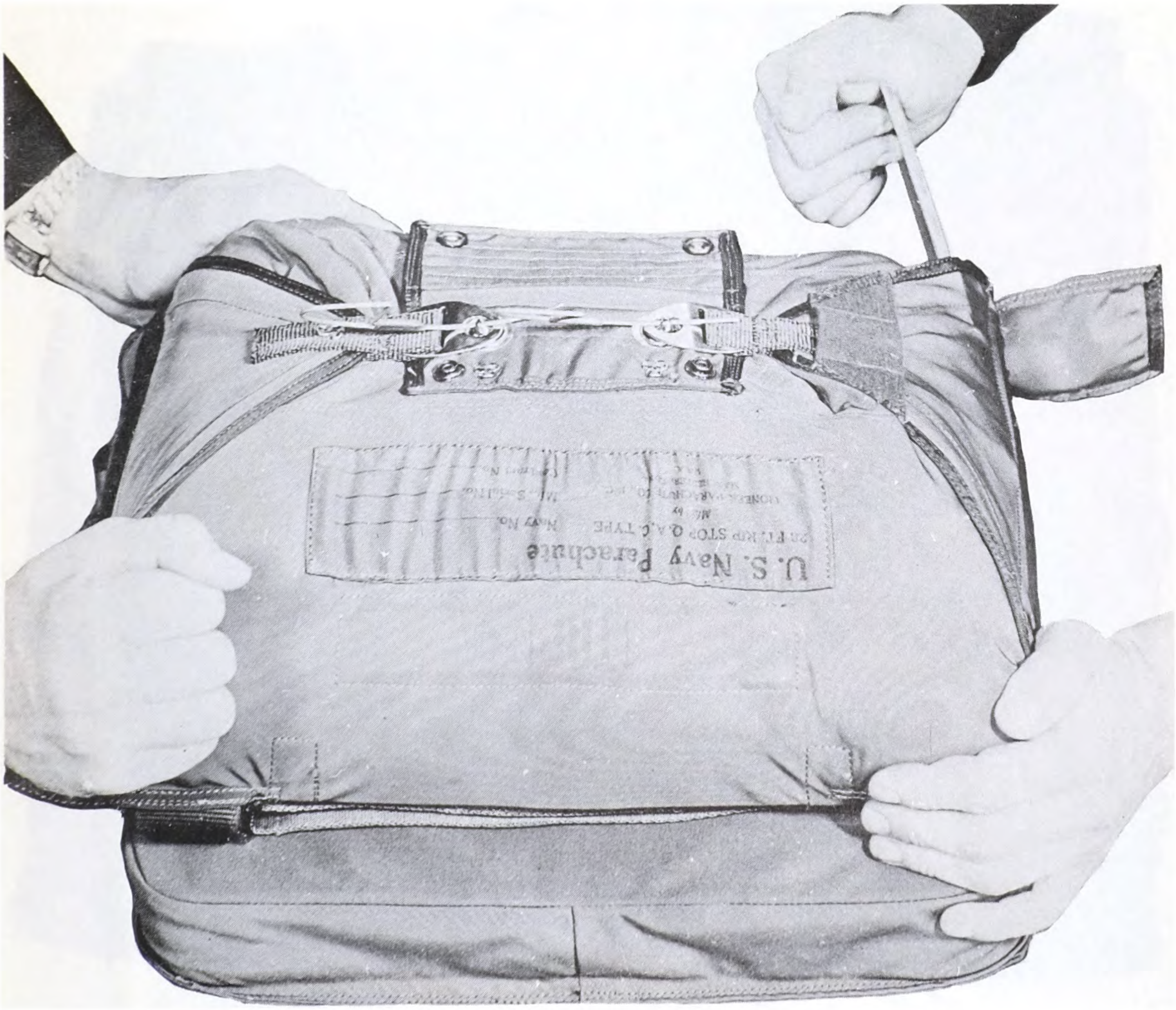


Figure 5-45.—Using the fid.

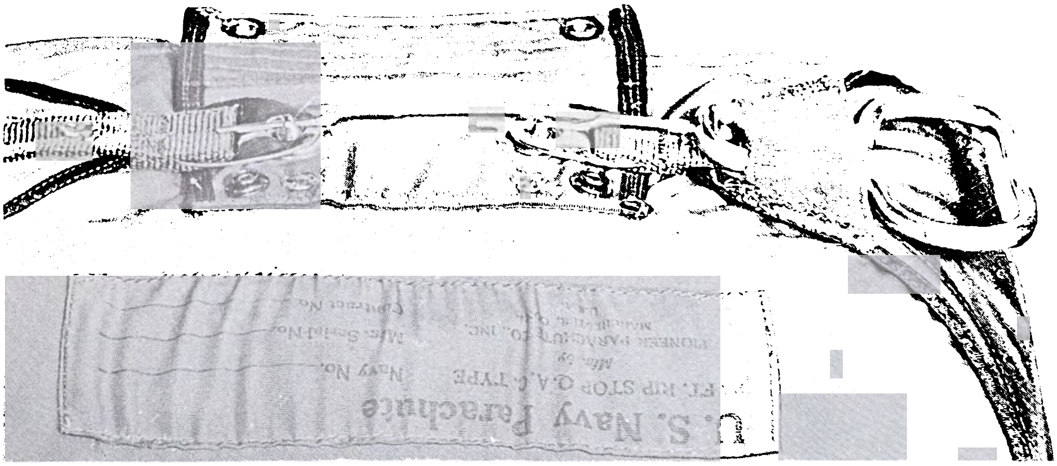


Figure 5-46.—Temporary pins removed and ripcord inserted.

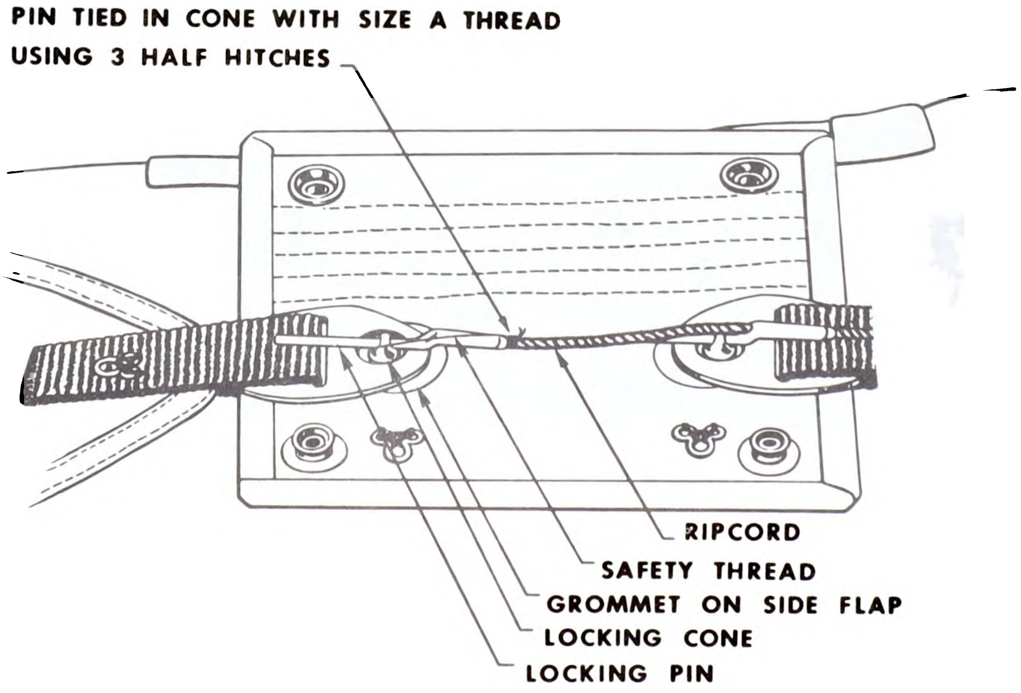


Figure 5-47.—Method of safety tying the ripcord locking pins.

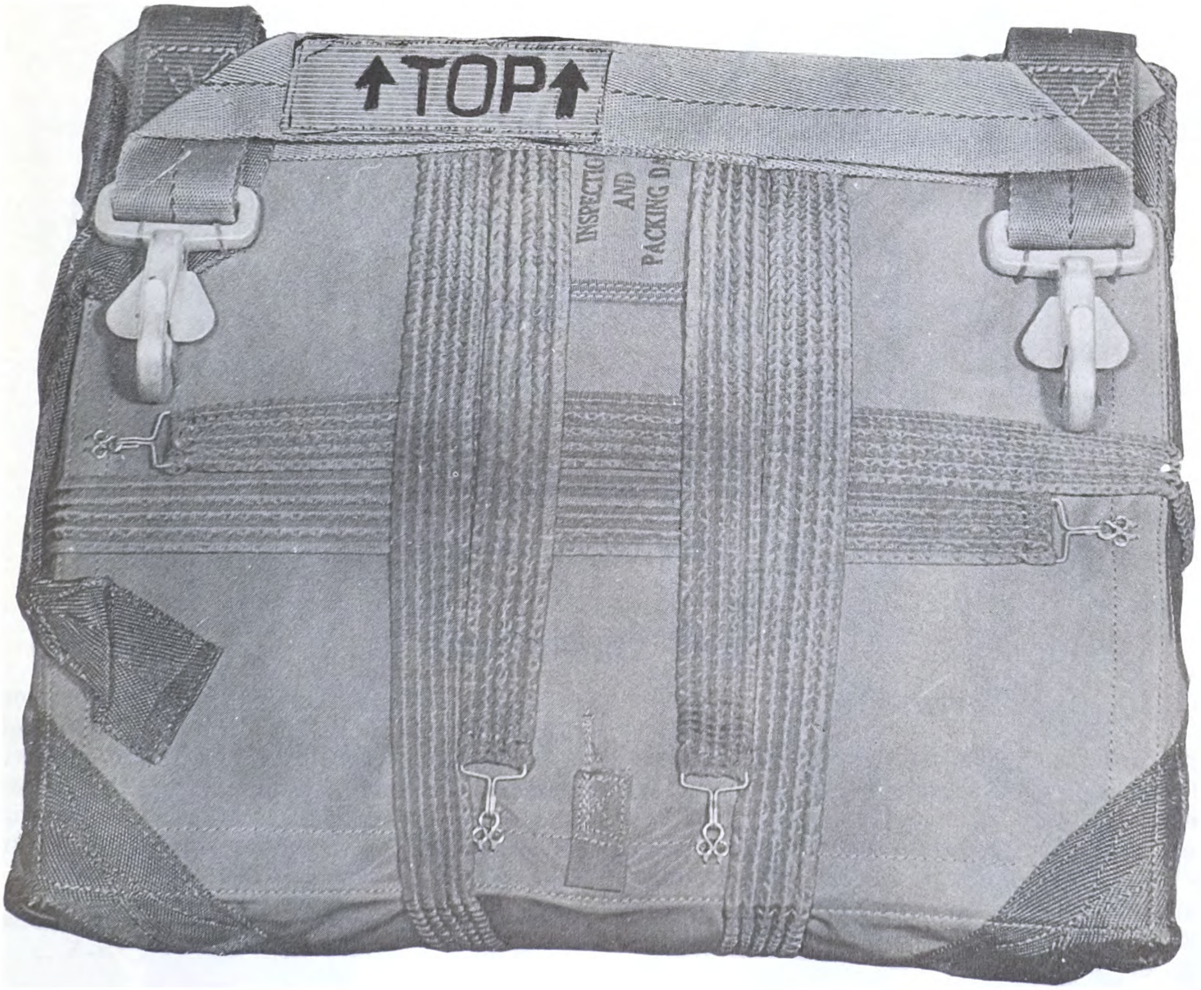
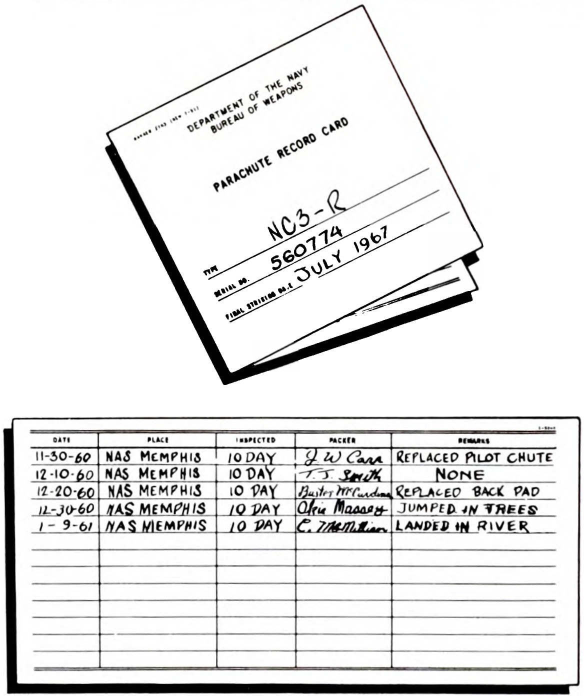


Figure 5-48.—Correct hookup pattern for pack opening bands.



DEPARTMENT OF THE NAVY
BUREAU OF WEAPONS

PARACHUTE RECORD CARD

TYPE NC3-R
SERIAL NO. 560774
FINAL STRIKING DATE JULY 1967

DATE	PLACE	INSPECTED	PACKER	REMARKS
11-30-60	NAS MEMPHIS	10 DAY	J. W. Carr	REPLACED PILOT CHUTE
12-10-60	NAS MEMPHIS	10 DAY	T. J. Smith	NONE
12-20-60	NAS MEMPHIS	10 DAY	Buster McCurdy	REPLACED BACK PAD
12-30-60	NAS MEMPHIS	10 DAY	Olvie Massey	JUMPED IN TREES
1-9-61	NAS MEMPHIS	10 DAY	C. McMillian	LANDED IN RIVER

Figure 5-49.—Parachute Record Card entries.

Quick-Fit Harness

ADJUSTMENTS

The quick-fit chest type parachute harness is designed to be adjusted by the individual wearing the parachute before the aircraft becomes airborne. Everyone concerned should know how to wear, adjust, and in this case, hook up his chest type parachute. It is the pilot's responsibility to make certain that all hands flying in his aircraft are checked out in this respect. Since this parachute is designed to be adjusted on the spot by the individual, no tackings need be made by the Parachute Rigger. However, if certain individuals desire the chest strap hardware to be tacked in place on the respective chest strap, it is permissible to make the two tackings as follows:

1. Measure down 6 to 8 inches from the shoulder adapters.
2. Position hardware.
3. Tack in place, using 6-cord nylon thread. (See fig. 5-50.)

Check out everyone in your squadron properly and the chances are that they will not want a tacked fitting. Once the individual has learned how to wear and adjust his harness, he may want to loosen this adjustment under certain conditions, perhaps move the chest hardware slightly up or down for comfort. Tacking the chest strap prevents any further movement of the hardware. Loosening the harness should be discouraged, as many people will forget to tighten it in an emergency.

Don the harness by slipping the arms between the chest and back straps. (See fig. 5-51.)

Pull both left and right leg strap ends downward diagonally to a snug fit. (See fig. 5-52.)

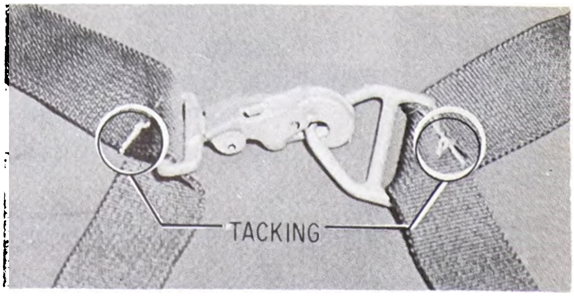


Figure 5-50.—Chest strap tacking.

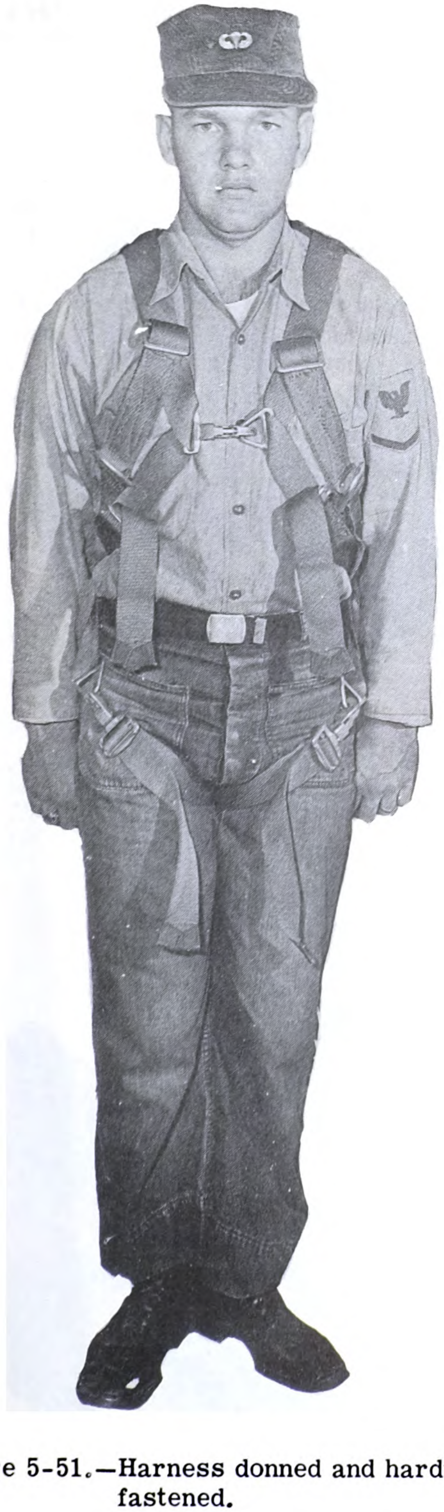


Figure 5-51.—Harness donned and hardware fastened.

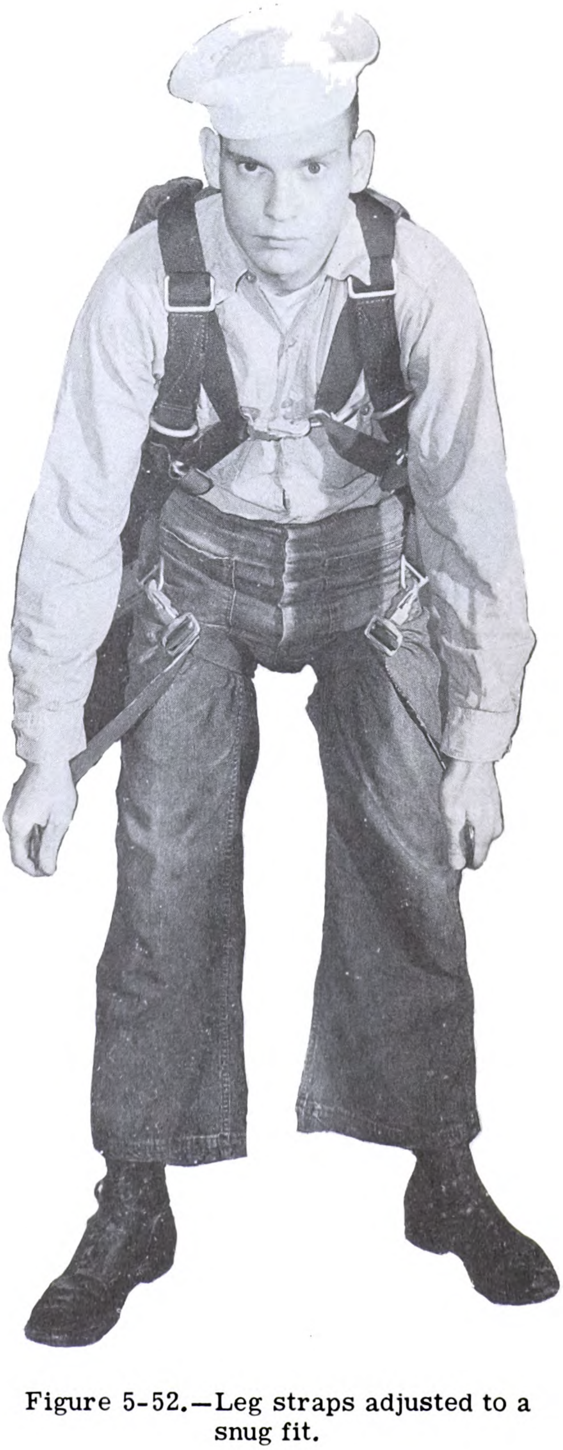


Figure 5-52.—Leg straps adjusted to a snug fit.

Pull upwards diagonally on both left and right chest strap ends until a snug fit is obtained. This operation removes all slack in the chest and back straps. The shoulder adapter should be located in the hollow just below the collar bone. If not so located, readjust until shoulder adapters are approximately located as shown in figure 5-53.

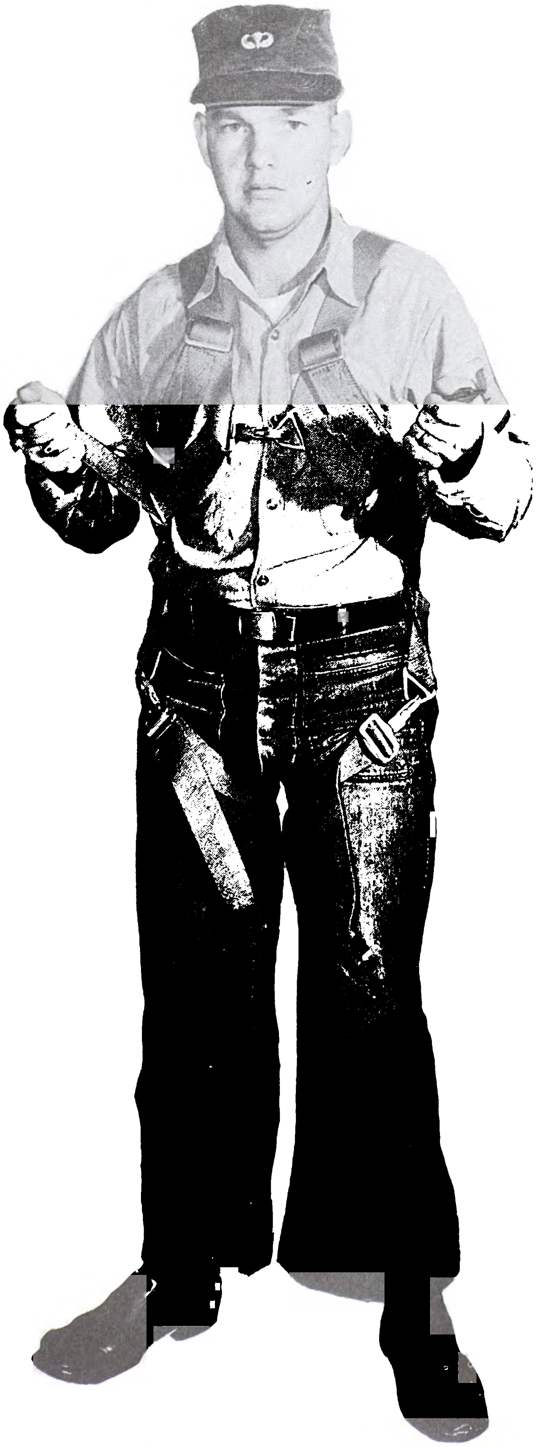


Figure 5-53.—Adjustment snug and completed.

The loose webbing ends may be tucked under their respective straps.

Figure 5-54 illustrates the manner in which the quick connector snaps of the parachute pack are engaged with the quick connector D-rings of the harness.

The chest type parachute pack and quick fit harness assembly when fully donned and adjusted appears as shown in figure 5-55.

The quick adjustable hardware used on the chest and leg straps operates on the friction lock principle. When a pull away from the hardware is exerted, the sliding bar, around which

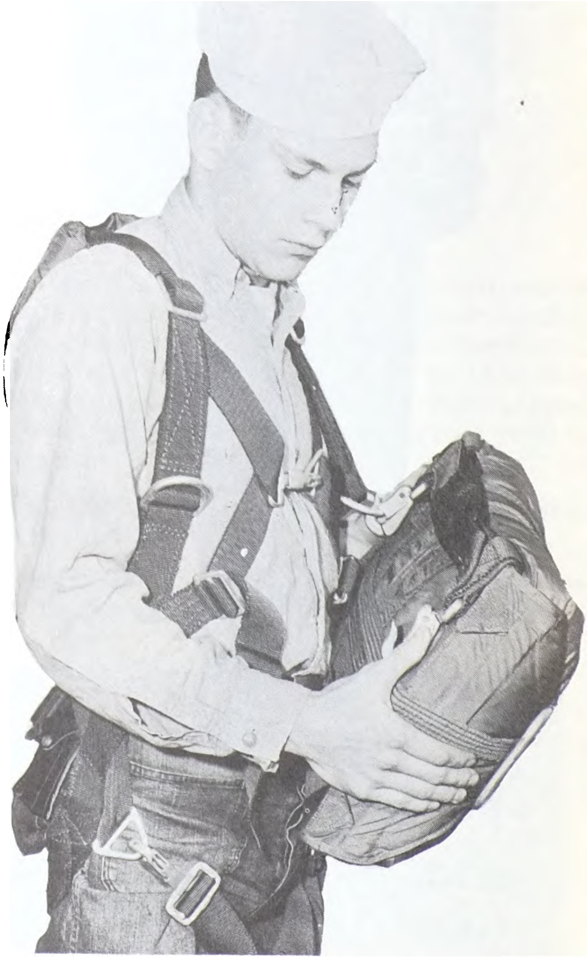


Figure 5-54.—Hooking up the pack.

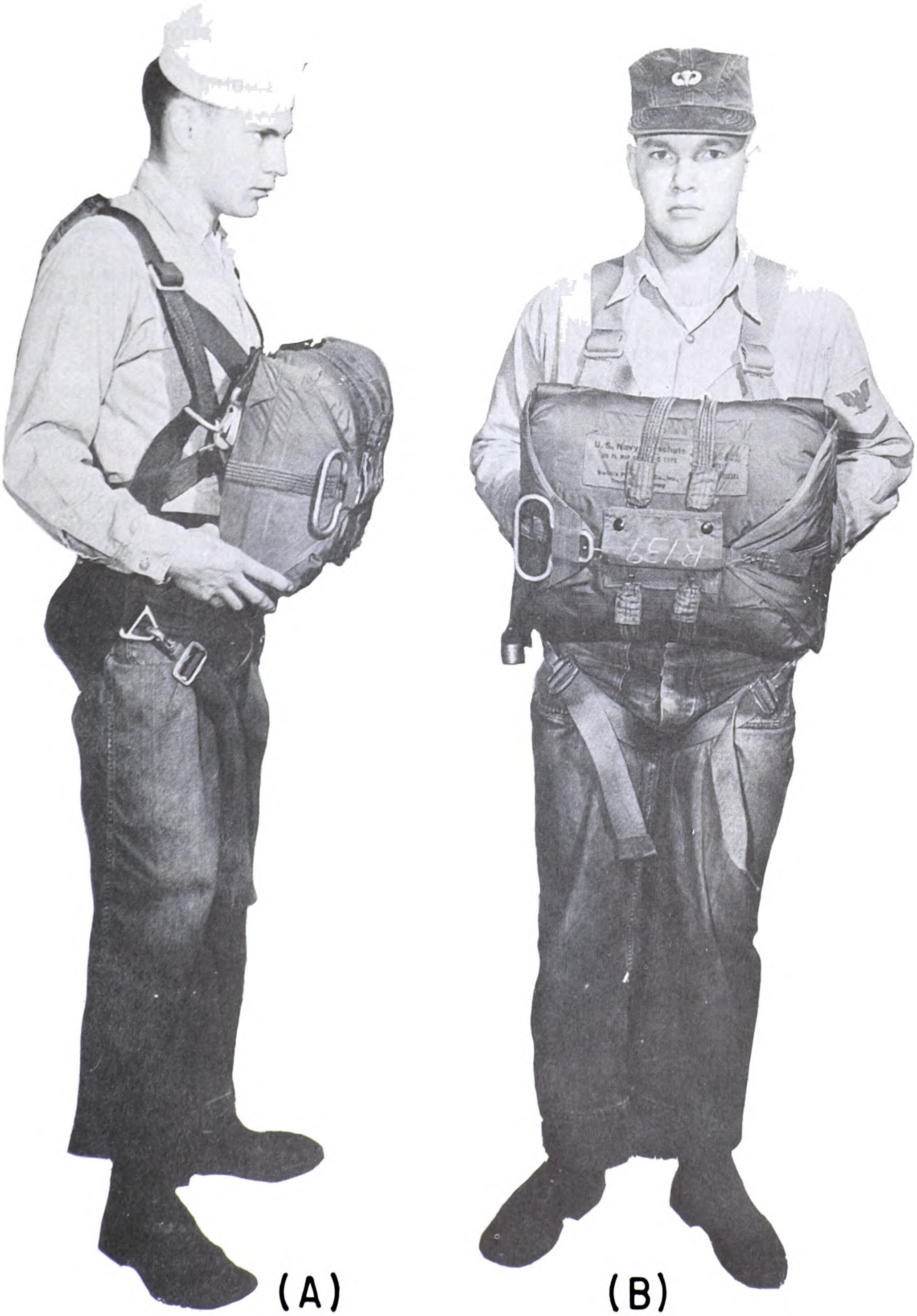


Figure 5-55.—Side view (A) and front view (B) of pack and harness.

the harness webbing is looped, moves in the direction of the pull, thus locking the webbing between the sliding bar and the stationary piece of the hardware.

To loosen the harness grasp the quick loosening tabs or V-rings, and tilt the friction snaps at right angles to the webbing, and pull. Harnesses equipped with ejector type hardware may be loosened as shown in figure 5-56.

CAUTION: "Dumping" the snaps will completely disengage the security of the harness.

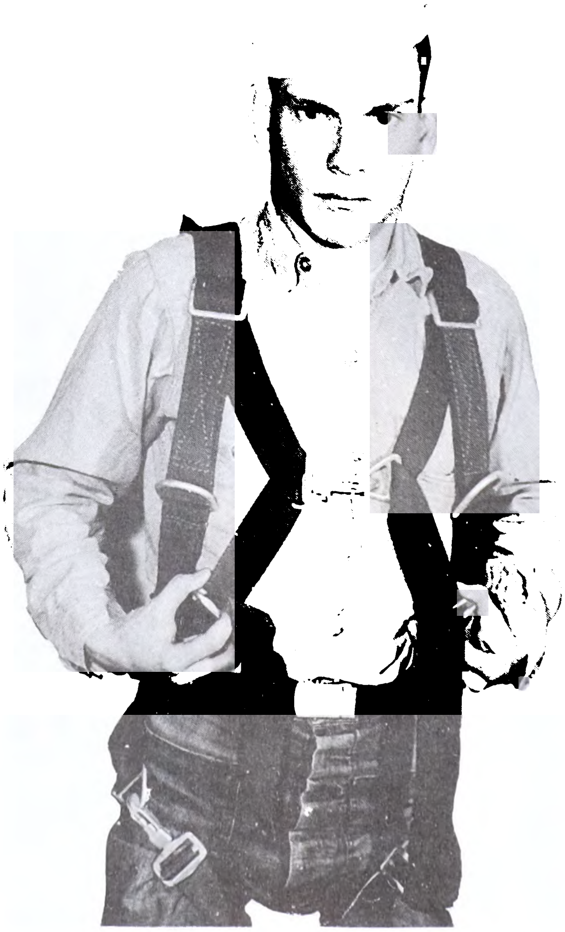


Figure 5-56.—Loosening the adjustment.

QUIZ

1. When laying out the NC-3 parachute for rigging, the tongues of the quick connector snaps should face
   a. toward the packer
   b. toward the helper
   c. up
   d. down

2. The NC-3 parachute may be rigged with the pararaft at the discretion of the
   a. shop chief
   b. safety and survival officer
   c. unit commander
   d. Bureau of Naval Weapons

3. The nylon tape used in securing the pararaft kit to the NC-3 container is
    a. 3/4 inch long
    b. 9/16 inch wide
    c. 3 inches long
    d. 4 1/2 inches long
4. The pararaft kit container is adjusted to the pararaft by
    a. tacking in the correct position
    b. tension on the pack opening bands
    c. adjusting the releasing mechanism
    d. adjusting two adapters
5. The part of the parachute which receives the most wear is the
    a. canopy
    b. pack
    c. pilot chute
    d. suspension lines
6. When hooking up the parachute for packing, the spreader bar is attached to the
    a. lift webs
    b. container
    c. suspension lines
    d. connector links
7. When whipping and folding the canopy, the gore which is most likely to need special attention is the
    a. top gore on packer's side
    b. top gore on helper's side
    c. bottom gore on helper's side
    d. bottom gore on packer's side
8. The packing step accomplished just prior to stowing the suspension lines is
    a. whip and fold the canopy
    b. inspect the hesitator loops
    c. sign and insert the inside Packing Record Card
    d. turn the container 90 degrees clockwise.
9. The suspension lines should be drawn through the hesitator loops approximately
    a. 1/2 inch
    b. 1 inch
    c. 1 1/2 inches
    d. 2 inches
10. The suspension lines from the last bight to the skirt hem should measure
    a. 12 to 18 inches
    b. 14 to 20 inches
    c. 16 to 22 inches
    d. 18 to 24 inches
11. When stowing the canopy, the skirt hem should be placed even with the
    a. cone side of the container
    b. grommet side of the container
    c. ripcord end of the container
    d. opposite to the ripcord end of the container
12. When stowing the canopy, the folds should be
    a. the same width as the container
    b. 2 inches narrower than the container
    c. 2 inches wider than the container
    d. 2 inches over each side of the container
13. If a pilot chute spring is bent
    a. use a longer connector cord
    b. replace the pilot chute
    c. bend the spring until straight
    d. replace the spring in the pilot chute
14. The Parachute Record Cards must be signed by the
    a. shop chief
    b. packer and the helper
    c. packer or the helper
    d. packer
15. The emergency signal code is stowed in
    a. the inside Parachute Record Card pocket
    b. the outside Parachute Record Card pocket
    c. a pocket on the cross connector strap
    d. a pocket attached to the parachute harness
16. The parachute harness should be adjusted by the individual wearing the harness prior to
    a. getting aboard the aircraft
    b. becoming airborne
    c. bailing out
    d. leaving the parachute loft
17. To make certain that aircrewmen know how to wear and adjust the parachute harness is the responsibility of the
    a. squadron Parachute Rigger
    b. plane captain
    c. pilot
    d. safety officer
18. When making the break tacking, the number of half hitches used is
    a. 1
    b. 2
    c. 3
    d. 4
19. To safety tie the ripcord pin use
    a. 1 surgeon's knot
    b. 1 clove hitch and 1 half hitch
    c. 2 half hitches
    d. 3 half hitches
20. When the parachute is worn, the ripcord would be on the
    a. wearer's right-hand side
    b. wearer's left-hand side
    c. top of the container
    d. bottom of the container

CHAPTER 6

PACKING AND RIGGING SEAT TYPE PARACHUTE

The Navy seat type (NS) parachute is one of the oldest types, but is still widely used in naval aviation. Parachutes of this general type are the NS-3 and NS-4. Both the NS-3 and NS-4 contain a 28-foot diameter, flat circular canopy. The NS-3 uses the standard harness with ejector type snaps, while the NS-4 uses the integrated torso harness.

Rigging the NS-3 Parachute

The seat type parachute is packed in about the same manner as the chest type, except the pack must be flatter. Certain minor variations in the packing often result in packs of varying thicknesses and contour which affect seat stability and pack height. Seat stability and pack height greatly affect comfort and the physical relation of the pilot to the aircraft. It has become increasingly important to effect uniformity and space economy in packing to provide parachutes of minimum thickness and relatively rectangular contour. The flat packing method insures a uniform pack thickness.

In the procedure outlined in this chapter for the seat type parachute, the steps involving procedures identical to the chest type (covered in the previous chapter) are omitted.

RIGGING WITHOUT PARARAFT

The rigging and flat packing steps (without the pararaft) are as follows:

1. Brush off the table.
2. Lay out tools and equipment. In this case, the tacking thread used to tack the lift webs in the pack will be lighter than the tacking cord used on the chest type parachute. Double nylon thread size E, tensile strength 8.50 pounds, is to be used. The use of anything heavier is contrary to instructions.
3. Lay out the seat type parachute, pulling the peak, and unchaining the suspension lines.

The pack, harness, ripcord housing, ripcord, ripcord pocket, seat cushion, and back pad are shown in figure 6-1, with all parts in their relative positions.

In step 3 the parachute was disassembled. The following procedure for assembling and rigging the parachute, including the inspection, is recommended. Figure 6-2 is a rigging diagram for the seat type parachute.

4. Clear the table, except for the canopy. Hook up the canopy, manufacturer's nameplate UP, and check the suspension lines for continuity. Remove dips and twists. Inspect the canopy.

After you have finished inspecting the canopy and the rotation of the suspension lines, release the tension on the parachute. Do not unhook the links. Check the harness for twists. Inspect the assembly carefully; now is the time to discover discrepancies.

Attach the back pad and lay out the harness in the proper position for attaching to the canopy. (See fig. 6-3.)

REMOVING CONNECTOR LINKS

Great care must be exercised in transferring each link from the retaining hooks of the table to the harness. There are numerous ways of doing this. The attachment steps are illustrated in figure 6-4, using the latest type removable links.

After each link screw has been tightened to a torque of 25 pounds, check the harness again for twists and the lay of the lift webs.

Hook up the parachute and recheck the suspension line rotation.

Release the parachute and prepare the pack for attachment to the harness. Check the pack for compliance with the latest modifications. Always inspect every new piece of equipment before assembling to the parachute.

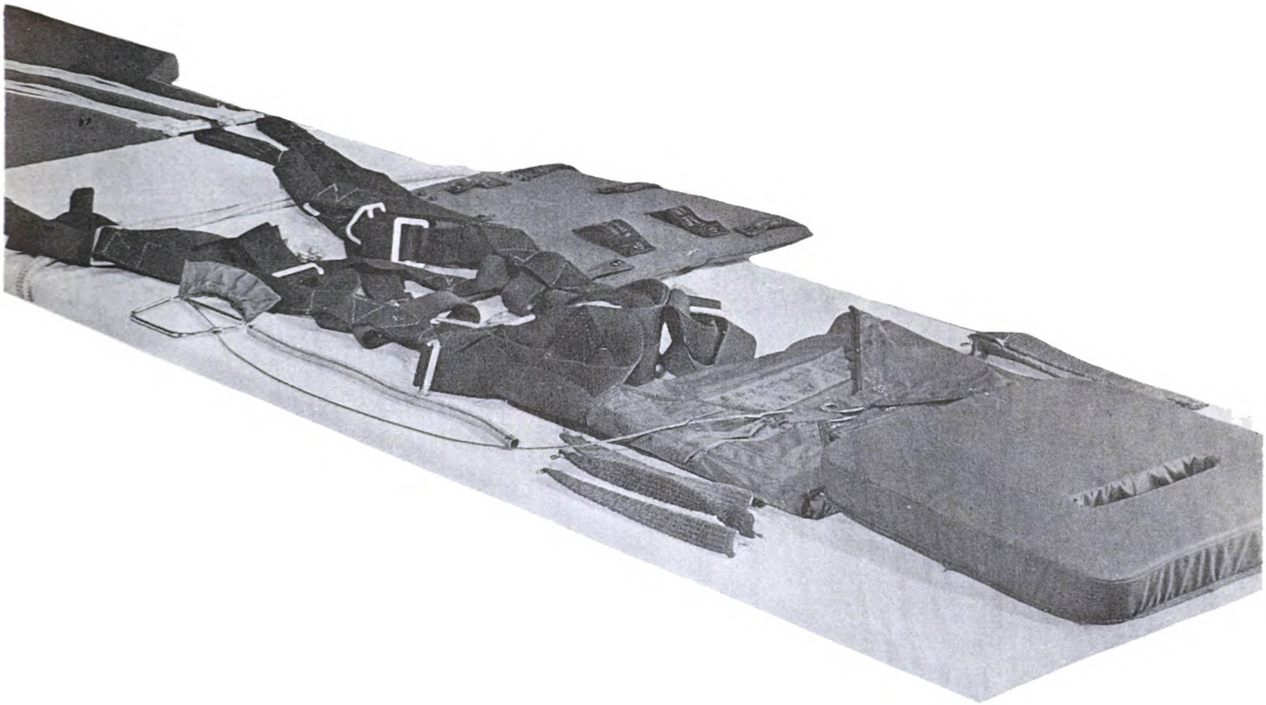


Figure 6-1.—Seat type parachute completely disassembled.

ATTACHING SEAT CUSHION

Attach the seat cushion. Draw the leg straps through the slot provided in the front half of the cushion. Tack to pack. (See fig. 6-5.)

Check the lift webs for twists. Position the lift webs in the pack and tack as shown in figure 6-6, using a double length of size E nylon thread. Form a single loop of thread on each side of the webbings by passing the needle through both thicknesses of webbing, the container fabric, corner reinforcements, and around the pack frame. Tie off, using a surgeon's knot.

RIGGING WITH PARARAFT

Attaching the pararaft kit to the seat type parachute is strictly a rigging problem. There is no change in the flat packing method, as this is the standard method of packing all seat type parachutes. Any seat type parachute shall be considered unacceptable for issue if it fails to pass the pack thickness gage check. This is especially important when it is rigged with the pararaft kit.

The pararaft kit is attached to the parachute by first unrigging the raft retaining straps, engaging them with the pararaft kit container keepers, and repassing the retainer straps back through the slots of the pack. A number of other important steps are involved in this process. The changeover to the pararaft kit is a major rigging job involving the disassembly of many appendages. Figure 6-7 illustrates the pararaft kit container and the PK-2 pararaft.

The rigging procedures for the pararaft kit are as follows:

1. Place the pararaft kit in the pararaft kit container and fasten the release mechanism.

2. With the aid of the two adapters, shown in figure 6-8, make certain that the pararaft kit fits snugly in its container and yet is not so tight as to make removal of the pararaft kit difficult in an emergency. Tack each adjustment with two turns of 6-cord nylon thread, single, to prevent slippage. Position these tackings through the free ends of the webbings and close to each adapter. Remember to tie off with a surgeon's knot and a square knot, and sear each cord end. This prevents unraveling.

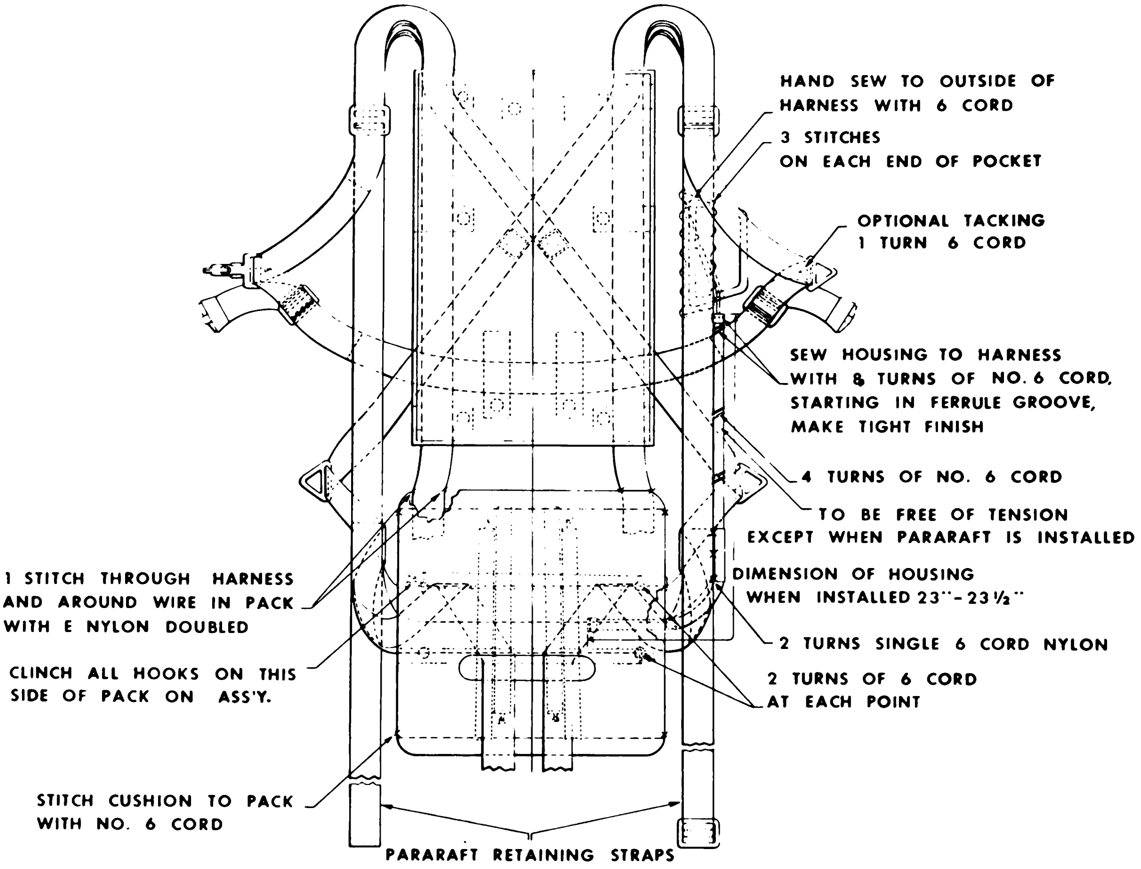

HAND SEW TO OUTSIDE OF HARNESS WITH 6 CORD
3 STITCHES ON EACH END OF POCKET
OPTIONAL TACKING 1 TURN 6 CORD
SEW HOUSING TO HARNESS WITH 8 TURNS OF NO. 6 CORD, STARTING IN FERRULE GROOVE, MAKE TIGHT FINISH
4 TURNS OF NO. 6 CORD
TO BE FREE OF TENSION EXCEPT WHEN PARARAFT IS INSTALLED
DIMENSION OF HOUSING WHEN INSTALLED 23"-23½"
2 TURNS SINGLE 6 CORD NYLON
2 TURNS OF 6 CORD AT EACH POINT
1 STITCH THROUGH HARNESS AND AROUND WIRE IN PACK WITH E NYLON DOUBLED
CLINCH ALL HOOKS ON THIS SIDE OF PACK ON ASS'Y.
STITCH CUSHION TO PACK WITH NO. 6 CORD
PARARAFT RETAINING STRAPS

Figure 6-2.—Rigging diagram for seat type parachute.

3. If the parachute has not been prepared to receive the pararaft kit, the following procedures must be followed to make it ready:

Release the parachute and stow the canopy and suspension lines in a chafing bag, or simply set aside on the table. Cut the lift web tackings and remove the lift webs from the pack.

Remove the ripcord and the ripcord housing from the harness. The housing need not be removed from the end flap of the pack.

Remove the seat cushion.

Cut the securing tackings holding the retaining straps. Slip the retainer straps out of the pack slots, completely disengaging the pack from the harness. Cut the remaining tackings holding the lift webs in the pack. The parachute is now ready to be rigged with the pararaft kit.

4. Position the harness and pack in the correct attitude. Run the pararaft retaining straps through the side web loops (or keepers) of the pararaft kit container and through the pack slots, as shown in figure 6-9, with the female portion of the quick release snap on top. Snap side faces out and up.

Pass the free end of the webbing through the adapter, which has been passed through the webbing keeper in the pararaft kit container and the pack slot. (See fig. 6-10.)

Draw the two containers together snugly, removing all excess slack in the retaining straps. Tack through the straps and container as shown in figure 6-11. Use two turns of 6-cord nylon thread as indicated. These operations are not performed while the pararaft kit is in the pararaft container. (See fig. 6-11.)

The opening bands should be attached at this point, as the next step will involve tacking the pararaft kit container close to the pack. Pass the leg straps through the keepers in the top of the pararaft kit container and reinsert the pararaft kit.

5. Lay the pararaft kit and container flat on the pack. Line up the rear edge of the pararaft kit container along the rear edge of the pack.

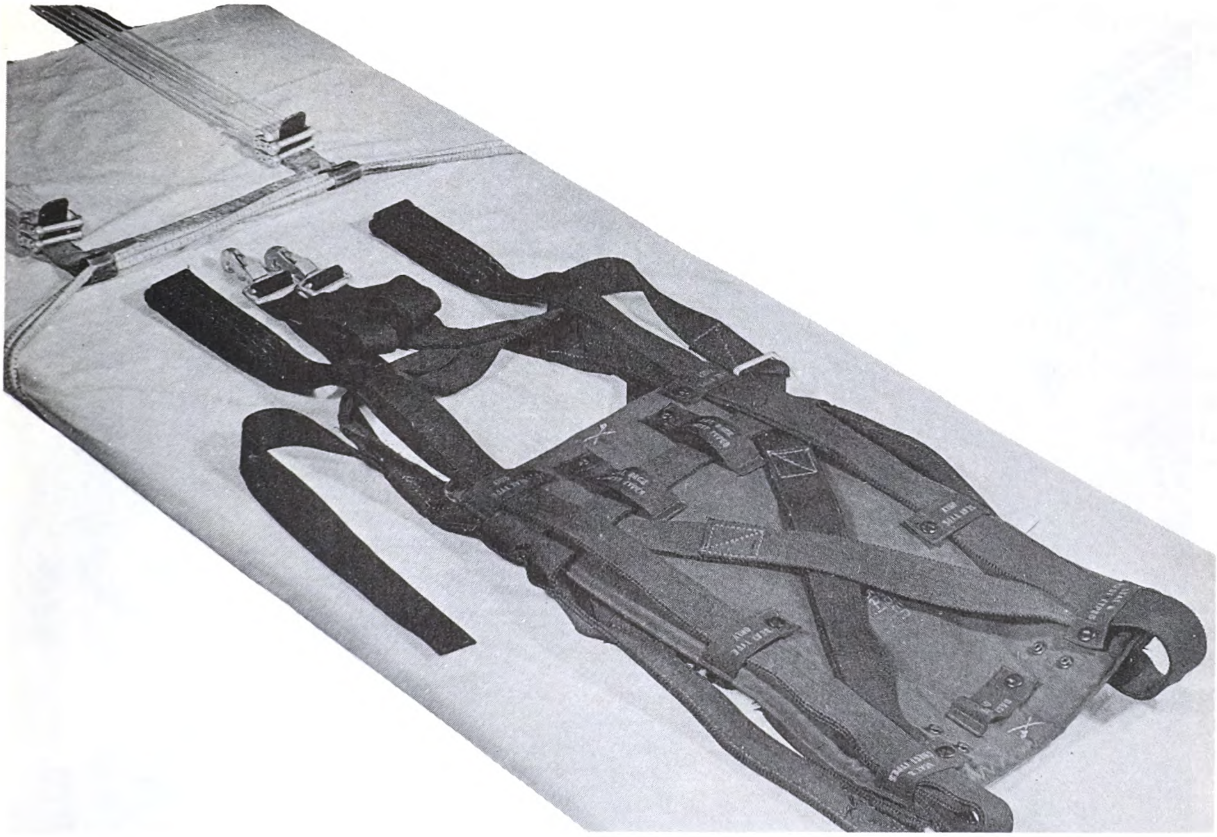


Figure 6-3.—Harness and canopy laid out in proper position for assembly.

When the pararaft kit protrudes over the front edge of the pack (by reason of size), compensate for this condition by shifting it slightly beyond the rear edge of the parachute pack. An extreme condition will require repacking of the pararaft kit. Straighten out any wrinkles or doubling under of the material of the container. Recheck the alignment of the container and pack. Make a visible mark with a light-colored crayon pencil at each tacking point on the parachute pack. After checking the relative sizes of the pararaft kit and parachute pack, an experienced Parachute Rigger may omit marking the tacking points. (See fig. 6-12.)

6. Remove the pararaft kit from the container to allow greater ease in performing the tackings and to prevent piercing the pararaft kit with the tacking needle. Tack the sides of the kit container to the parachute pack (fig. 6-13), using one turn of double 3- or 6-cord nylon thread. Be sure that the tackings pass around the wire frame of the parachute pack.

7. Tack the front of the pararaft kit container to the parachute pack (fig. 6-14), using one turn of double 3- or 6-cord nylon thread. Two turns of cord (single) may be substituted for one turn (double), if one turn fails to hold properly. Pass tackings around the pack frame, maintaining a neat tacking pattern.

Reinsert the PK-2 into its container and fasten the releasing device. CENTER the HARNESS and tack with one turn of 6-cord nylon thread, doubled, to PREVENT SLIPPAGE. (See fig. 6-15.) Before making the tacking, disengage the releasing device and lift the top of the PK-2 container away from the raft case.

8. Place a seat cushion over the main sling and pass the leg straps up through the slot provided in the cushion. Tack the seat cushion in position. Make a reference mark on both sides

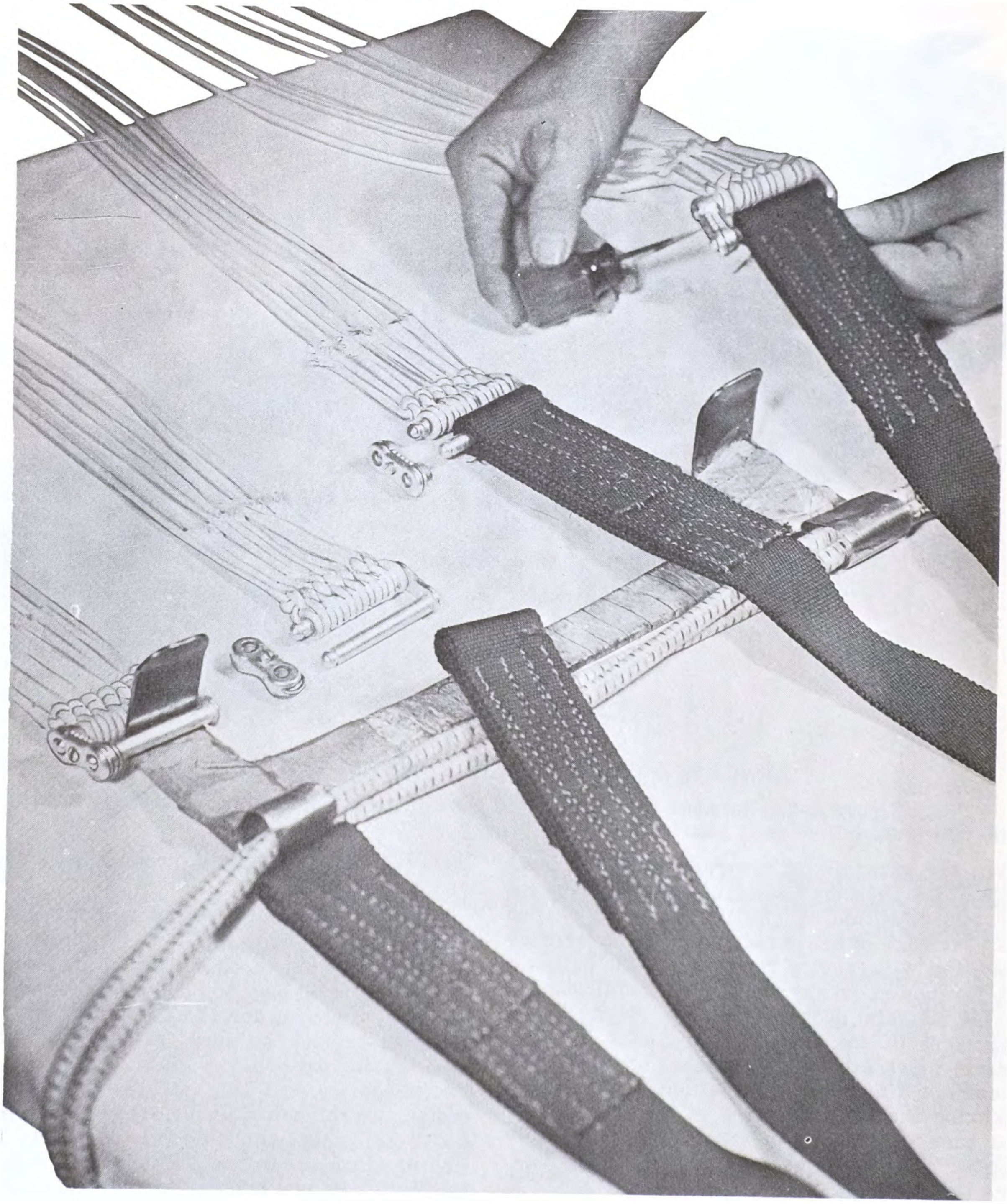


Figure 6-4.—Attachment steps in connecting the links to the harness.

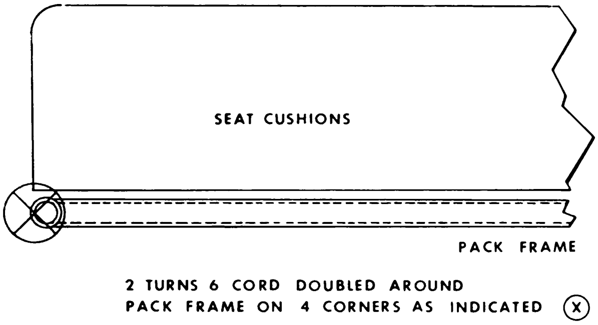

SEAT CUSHIONS
PACK FRAME
2 TURNS 6 CORD DOUBLED AROUND
PACK FRAME ON 4 CORNERS AS INDICATED ⓧ

Figure 6-5.—Seat cushion tacking to pack.

of the forward side tacking points. Remove the PK-2 and make four tackings (fig. 6-16), using one turn of double 3- or 6-cord nylon thread.

9. Reinsert the pararaft kit. Do not fasten the releasing device. Make the last two forward tackings (fig. 6-17), using one turn of double 3- or 6-cord nylon thread.

10. Refasten the releasing device and retack the lift webs.

ATTACHING RIPCORD HOUSING

When the pararaft kit is not used in the parachute assembly, the pararaft retainer straps are pulled entirely through the 2-inch slots located on the ends of the pack. (See fig. 6-18, views (A) and (B), for rigging instructions.) As the retainers are being drawn tightly together, line up the centerline of the harness with the centerline of the pack. Guard against twisting the harness and retainers. The leg straps must be facing the forward edge of the pack in order for the lift web slots to be in the correct position for receiving the lift web assembly.

Pass the extensible ripcord housing through the sleeve located on the ripcord end of the pack. Close the pack and fold the ripcord protector flap down over the locking cones. Mark a line on the end flap of the pack along the edge of the ripcord protector flap. (See fig. 6-19.)

Draw up the housing ferrule within 1/8 inch of the reference line made on the end flap and hand sew housing. (See fig. 6-20.)

Take the free end of the housing and pass it through the sleeve on the main sling. (See fig. 6-21.) This will prevent unnecessary exposure of the ripcord housing and entanglement with cockpit projections.

The extensible housing and ripcord now being used on the seat type parachute has lessened the possibility of a premature opening. However, before tacking the housing and ripcord pocket to the harness, the best policy is to pack the parachute. Attach the pack opening bands to the anchoring eyes located on the underside of the pack.

Attach the seat cushion. Draw the leg straps through the slot provided in the front half of the cushion. Tack to pack as previously illustrated in figure 6-5.

Check the lift webs for twists. Position the lift webs in the pack and tack, using a double length of size E nylon thread. Form a single loop of thread on each side of the webbings by passing the needle through both thicknesses of webbing, the container fabric, corner reinforcements, and around the pack frame. Tie off, using a surgeon's knot.

RIGGING WITH BAILOUT CYLINDER

This equipment is supplied for the use of flight personnel undertaking extended or frequent flights above an altitude of 25,000 feet.

The bailout unit consists of a cylinder, a metering orifice, a refill valve, a pressure gage, a ball pull handle, a caution tag and pin, a tube,

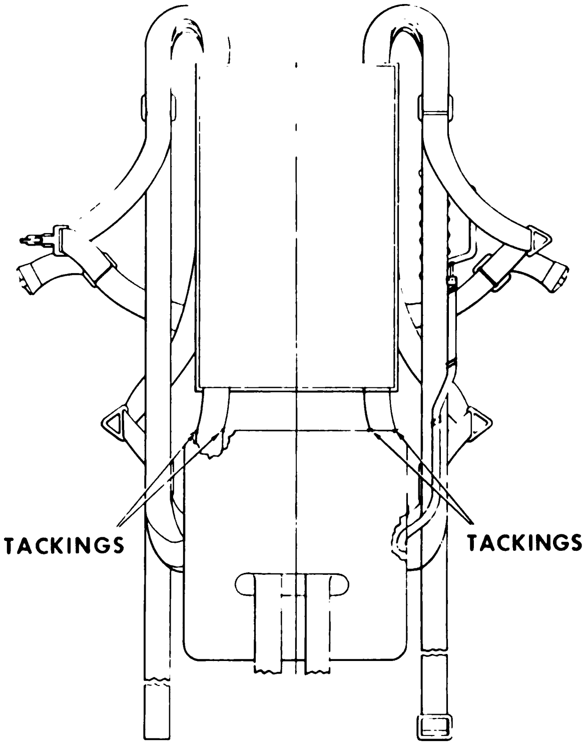


Figure 6-6.—Lift web tacking.

and a mask adapter. When the caution tag is disengaged and the ball handle pulled, oxygen will flow through the orifice up to the mask adapter via the tube.

The oxygen cylinder assembly is installed in the SP-1 or SP-1A seat pan attached to the seat type parachute. It is positioned near and parallel to the leading edge of the seat pan so that the ball pull handle and tube end of the assembly is to the right. The pressure gage is visible through a reinforced opening in the top of the seat pan. (See fig. 6-22.)

Packing the NS-3 Parachute

Hook up the parachute and make preparations for packing. The canopy has been inspected. Restraighten the skirt hem of the canopy. Figure 6-23 illustrates the proper method of laying out the parachute under tension for packing.

The parachute can be delivered to you for packing in a number of ways: packed, unpacked, unpacked and disassembled, and new from Supply in a metal container.

1. Whip and fold the canopy. All phases are the same as for the chest type parachute. The dimensional width of the last two folds has been increased. (See fig. 6-24.)

2. Unhook and prepare the pack to receive the suspension lines. (See fig. 6-25.) Sign the inside Parachute Record Card and insert it in the pocket.

3. Insert suspension lines in pack.

4. Place the canopy on the pack. (See fig. 6-26.) The skirt is brought up to the ripcord end and the canopy is permitted to drape over the sides of the pack for approximately 3 inches.

The short fold is placed conventionally behind the skirt hem, but the opposite end is allowed to extend over the pack end 3 to 4 inches. See fig. 6-27.)

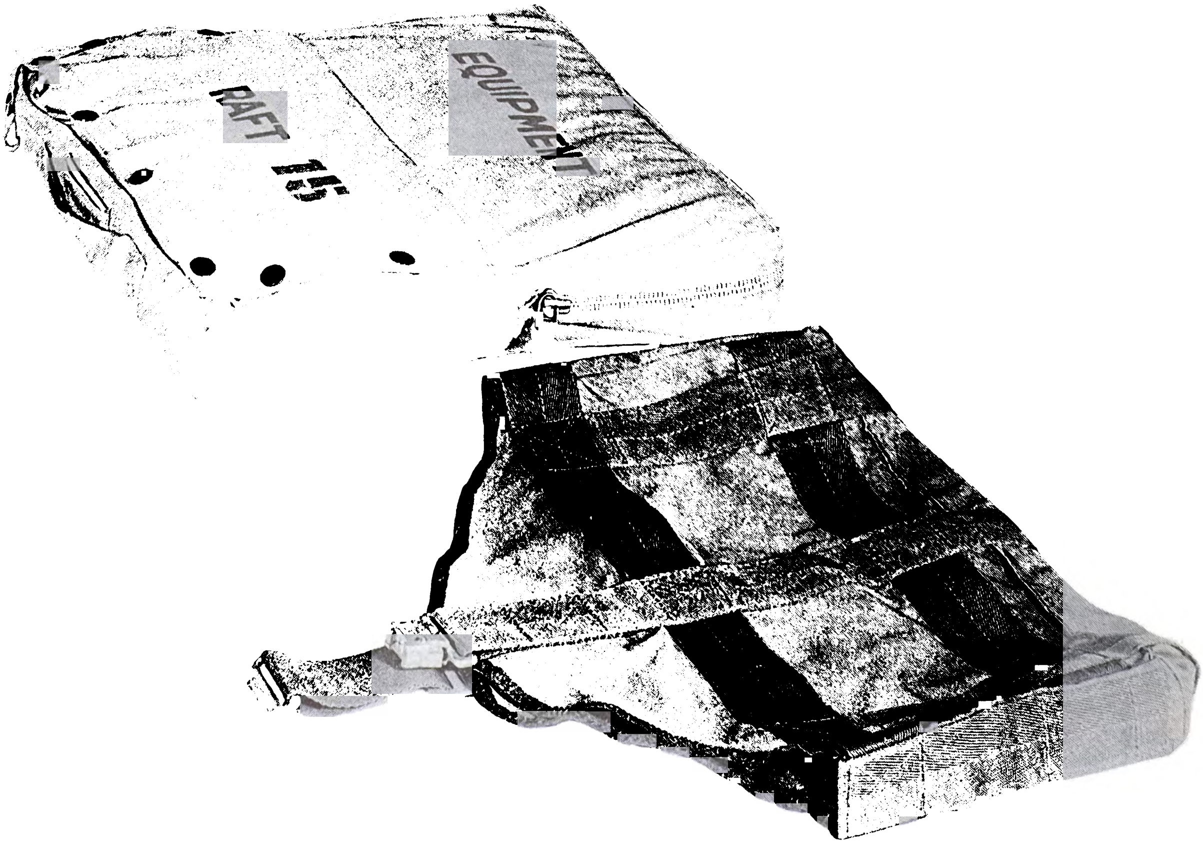


Figure 6-7.—Model PK-2 pararaft and kit container.

Place the remaining folds of the canopy to extend beyond all sides of the pack for a distance of approximately 3 or 4 inches (See fig. 6-28.)

5. Position the pilot chute the same as for the chest type parachute.

6. Partially close the pack while maintaining the flat condition by forcing the canopy down and to the sides. (See fig. 6-29.)

7. Completely close the pack and insert the ripcord, smoothing out the added bulk of the canopy with the long bar. However, the fid may have to be used before the long bar is used to straighten the end flaps. Take care not to tear out the end flap pockets. The finished flat pack should not be any thicker than 6 inches at its thickest point.

Do not permit the canopy to protrude or show at the corners of the pack. It may be necessary, at the next scheduled packing, to move the lift web protector flaps toward the ends of the pack to accomplish this successfully. Prior to the flat packing method, this was not necessary as the end flaps were not under the extreme tension they now are. Figure 6-30 illustrates the procedure to follow in repositioning the lift web protector flaps.

The pack is now completely closed and straightened. (See fig. 6-31.) The ripcord pins have been inserted in the locking cones. If the parachute were fully rigged (ripcord grip pocket in place), the ripcord handgrip would now be inserted in the handgrip pocket on the harness.

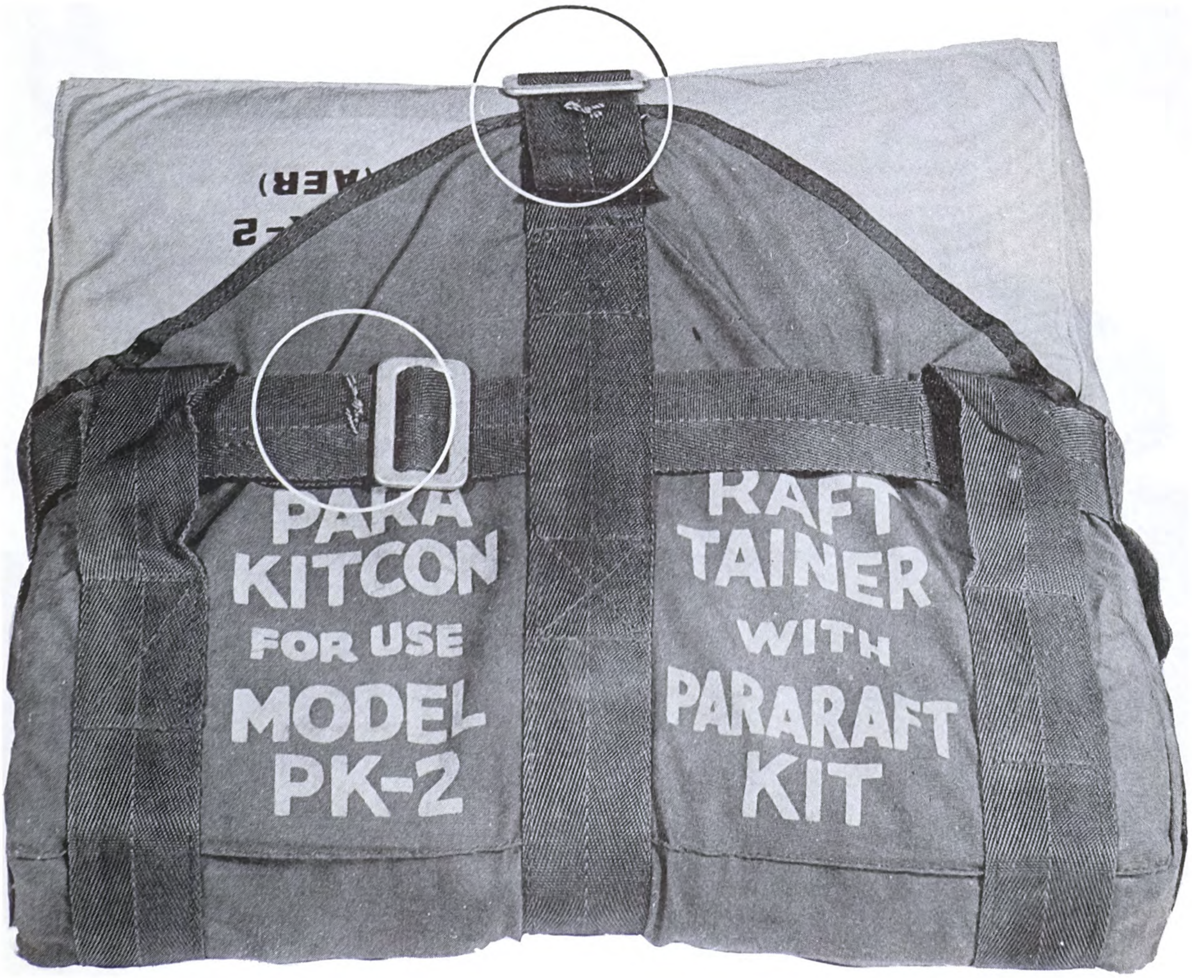


Figure 6-8.—Fit the kit container to the pararaft kit.

Measure the thickness of the pack using any acceptable 6-inch gage.

8. Safety tie locking pins the same as for chest type parachute.

9. Hook opening bands to the side and end flaps, using the same procedure as for chest type parachutes, except that the opening bands are not as easily accessible. Since the opening bands all measure the same length and the pack is rectangular, you will encounter great difficulty in locating the end flap opening bands. In order to have made these bands more accessible and to speed up the packing process, it is good practice to engage their free ends in any projection that offers itself near the ends of the pack before beginning packing. This could be done when a fully rigged parachute was being prepared for dry locker. Since the parachute is being packed and rigged from a completely unrigged condition, you must consider the advisability of hooking all of the opening bands to their respective anchoring eyes at this time. The ripcord pocket and housing have yet to be hand sewed in place on the harness. At the completion of these sewings or tackings, a test for

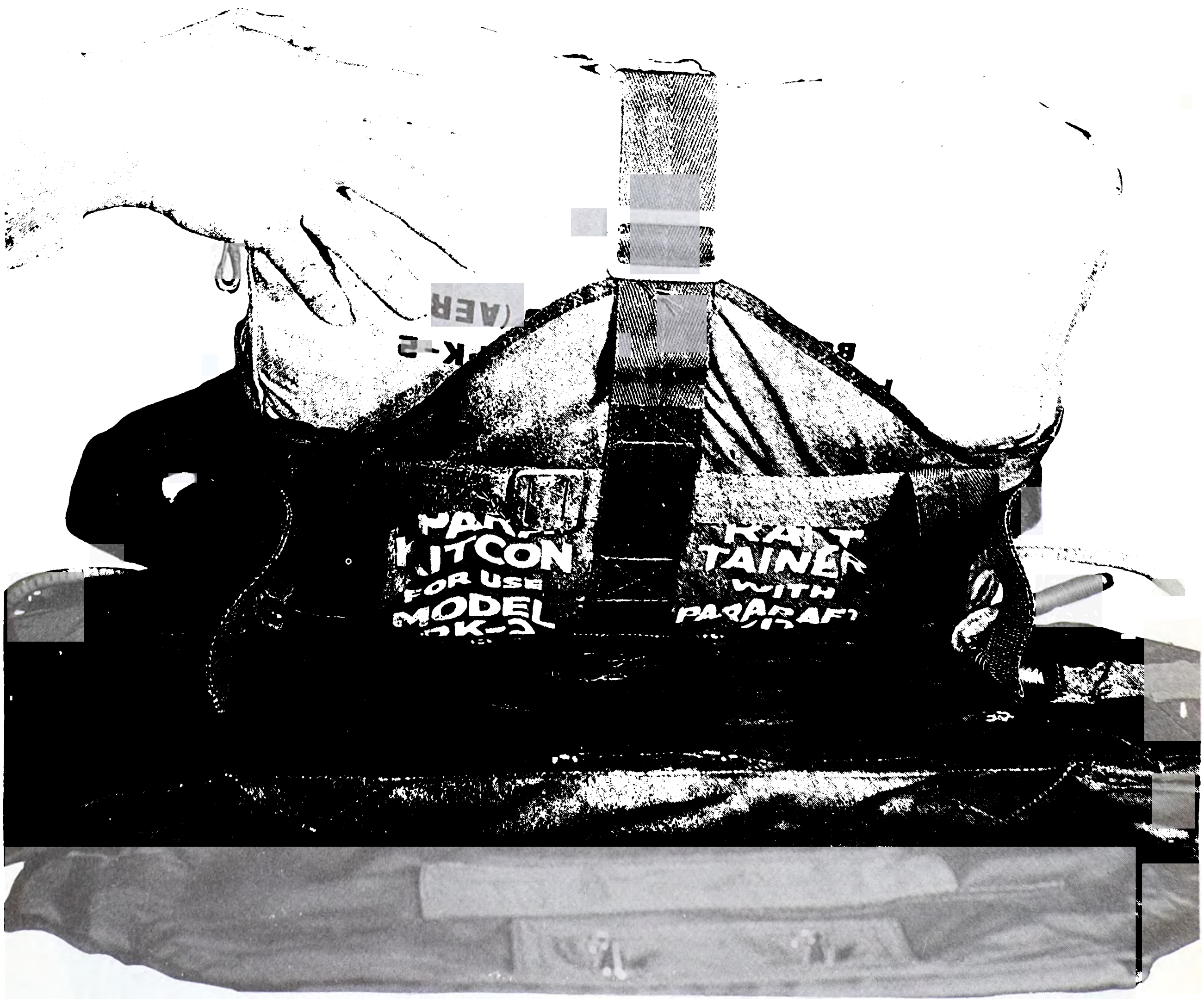


Figure 6-9.—Passage of the pararaft retainer straps through the pack slots before engaging the adapter.

premature opening is made. Do not fasten the protector flap snaps until after the ripcord test.

10. Make tests and adjustments. This refers directly to the position of the handgrip pocket and the housing tackings. An improperly positioned ripcord assembly can cause a dangerous premature opening of the parachute. Every precaution must be taken to guard against this hazard. Figure 6-32 illustrates the remaining harness tackings to be made to the ripcord housing and pocket. In order to acquire the correct amount of elastic grip on the handle, hand sew the pocket to the harness with the handle inserted in the pocket. Always take the ripcord handgrip out of the pocket after this sewing is completed to check the grip of the pocket on the handgrip. This action also shows that the handgrip has not been sewed in the pocket.

Set the pack on end and grasp the harness through the handgrip and subject the harness to a vigorous steady pull of about 50 pounds (fig. 6-33). If the pocket is located too high on the harness or the housing has been tacked without leaving enough slack between the end flap tacking and first harness tacking, the ripcord pins can be drawn out of the tacking cones without pulling the ripcord. If the safety tie around the ripcord pin breaks on this test, a dangerous premature condition exists and must be corrected BEFORE the parachute can be signed for and ISSUED. An offcentered harness can be the cause of this condition. Too much slack in the retaining webbings will permit the pack to pull away from the harness, adding to the hazards of a premature opening. The extensible type ripcord has given the Rigger a greater margin in

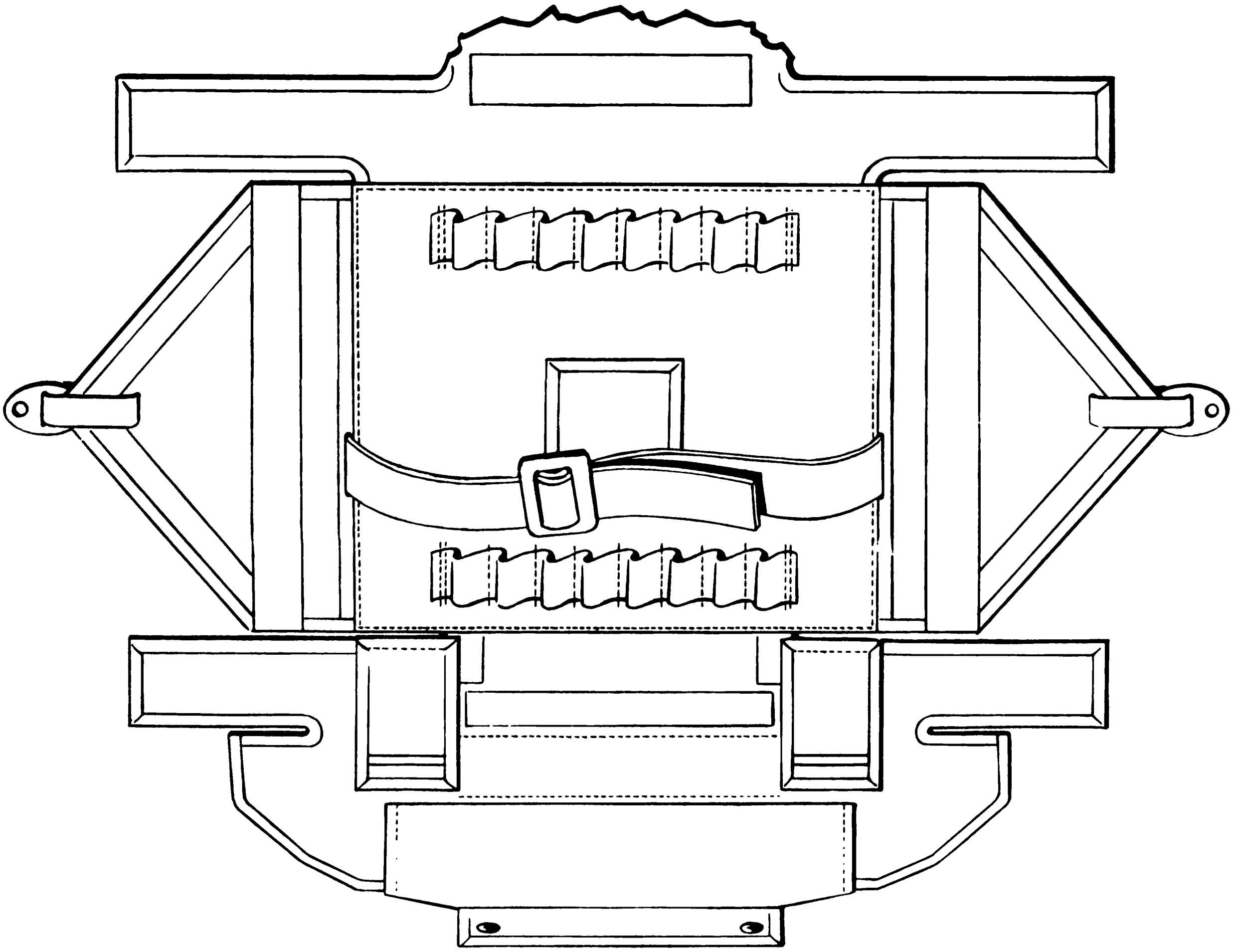


Figure 6-10.—Passage of the pararaft retainer straps after engaging the adapter.

postioning the handgrip pocket. However, do not acquire the bad practice of failing to make the premature opening test regardless of the advantage of additional slack designed in the releasing device.

11. Sign the Parachute Record Card the same as for the chest type parachute, and make an entry on the corresponding Parachute History Card.

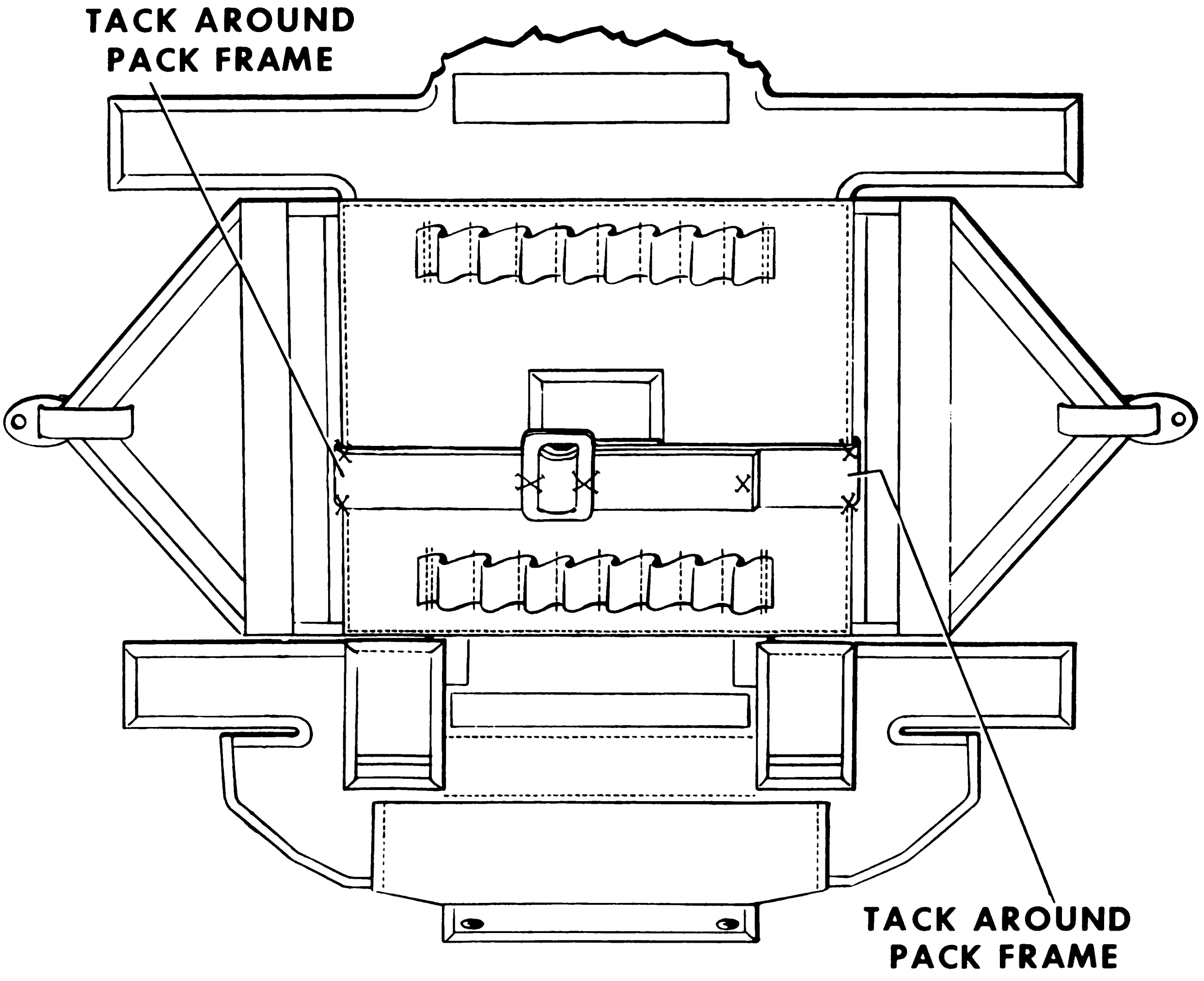


Figure 6-11.—Last adjustments tacked in place on the pararaft kit container retaining straps.

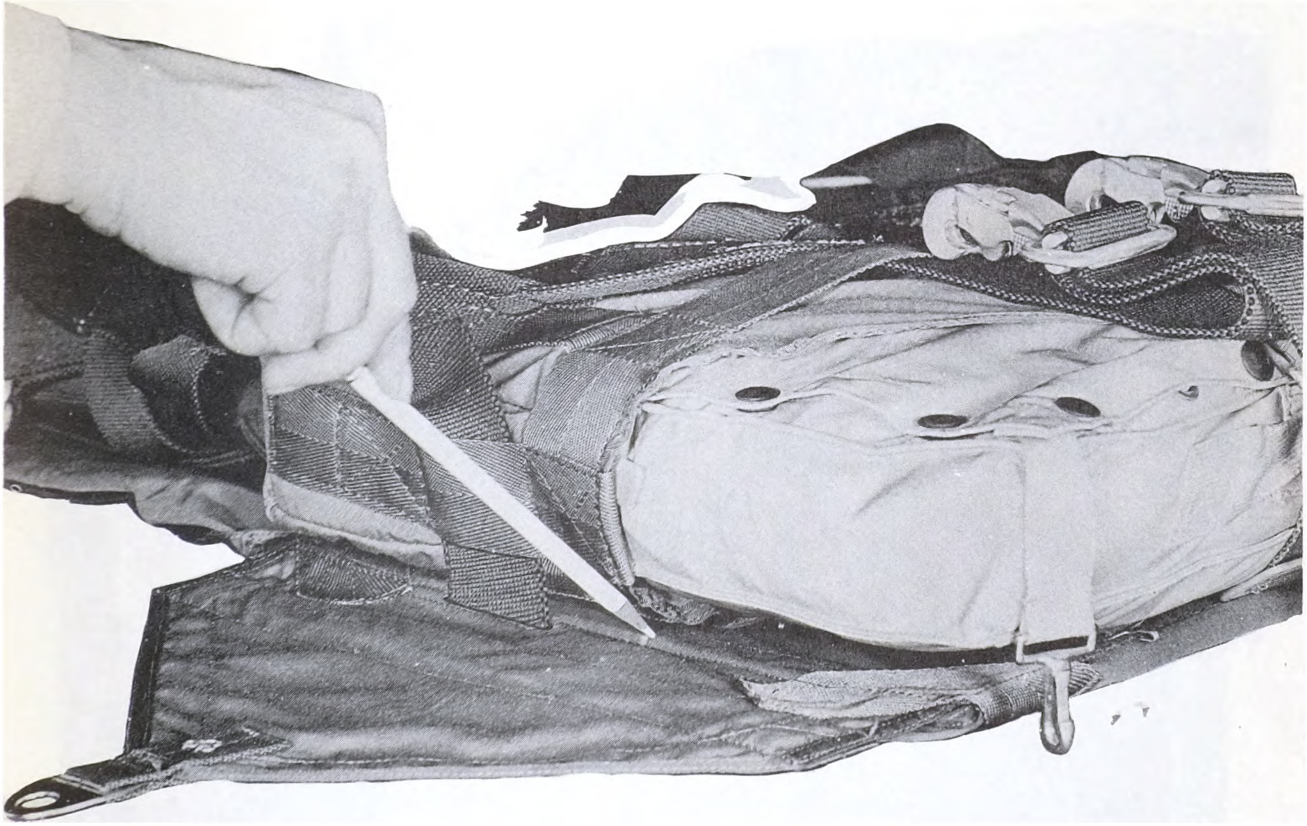


Figure 6-12.—Reference point for forward side tackings. The same reference mark is made on the opposite side.

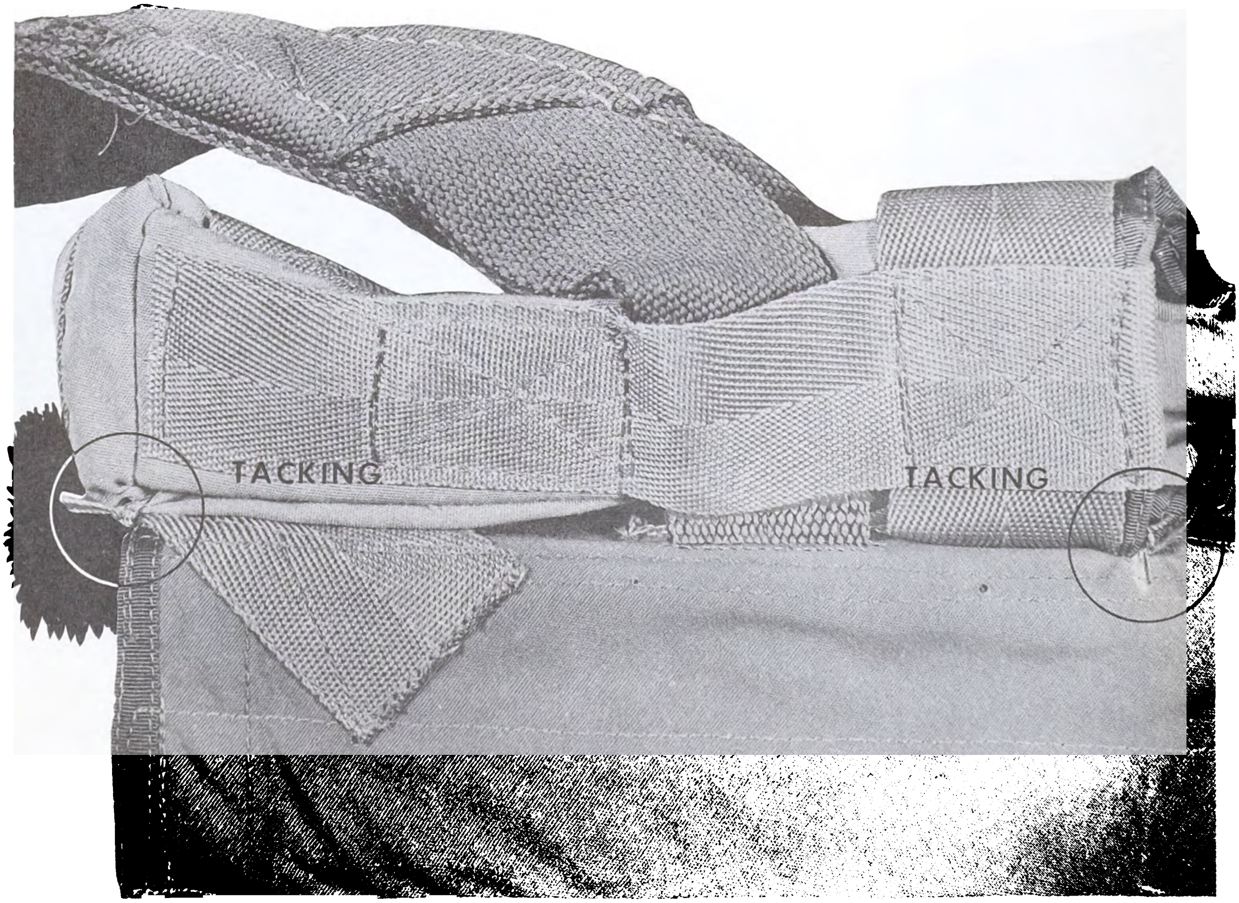


Figure 6-13.—Four tacking points: two as indicated and two on the opposite end of the pack.

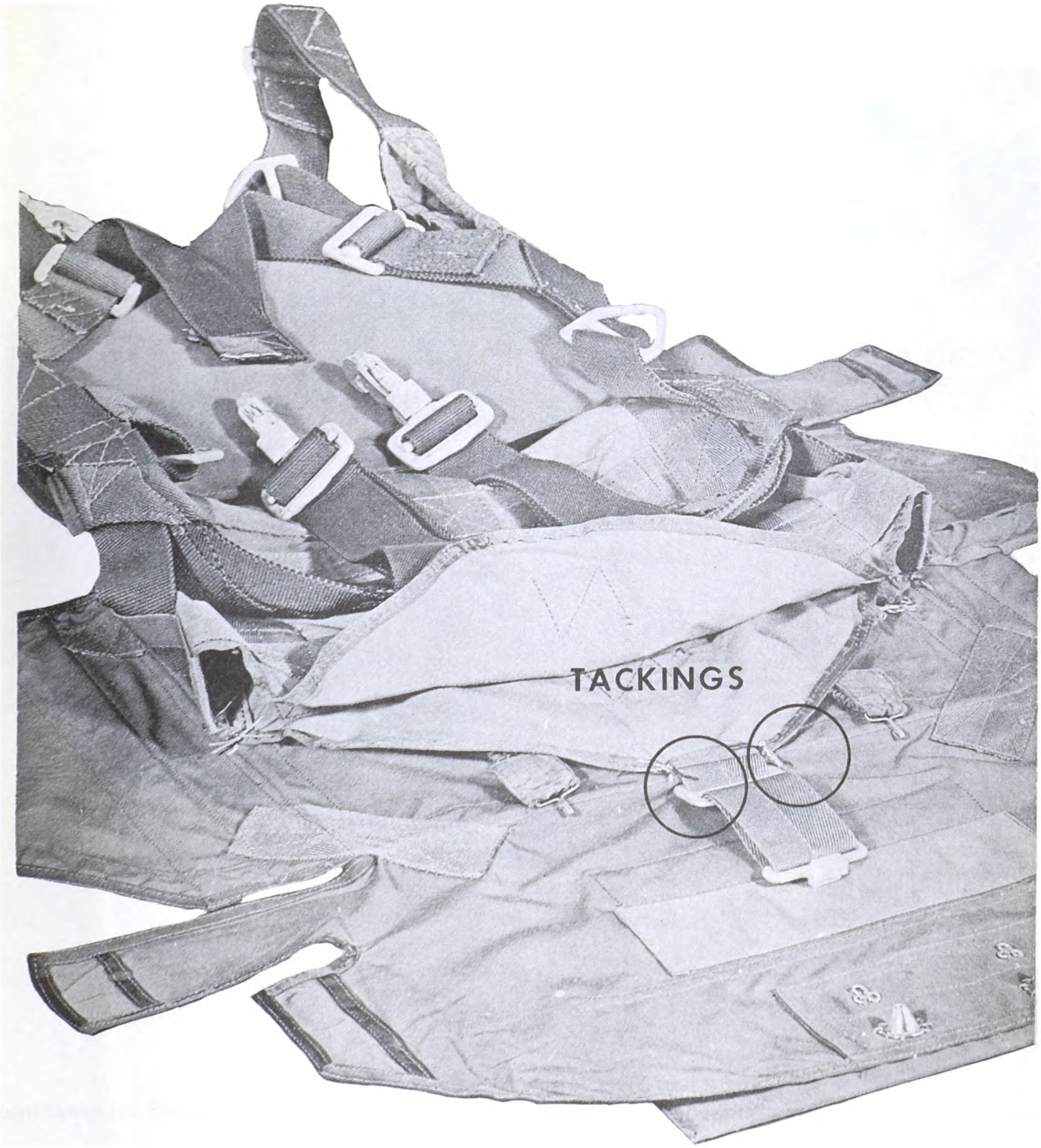


Figure 6-14.—Note that tackings do not pass through webbing.

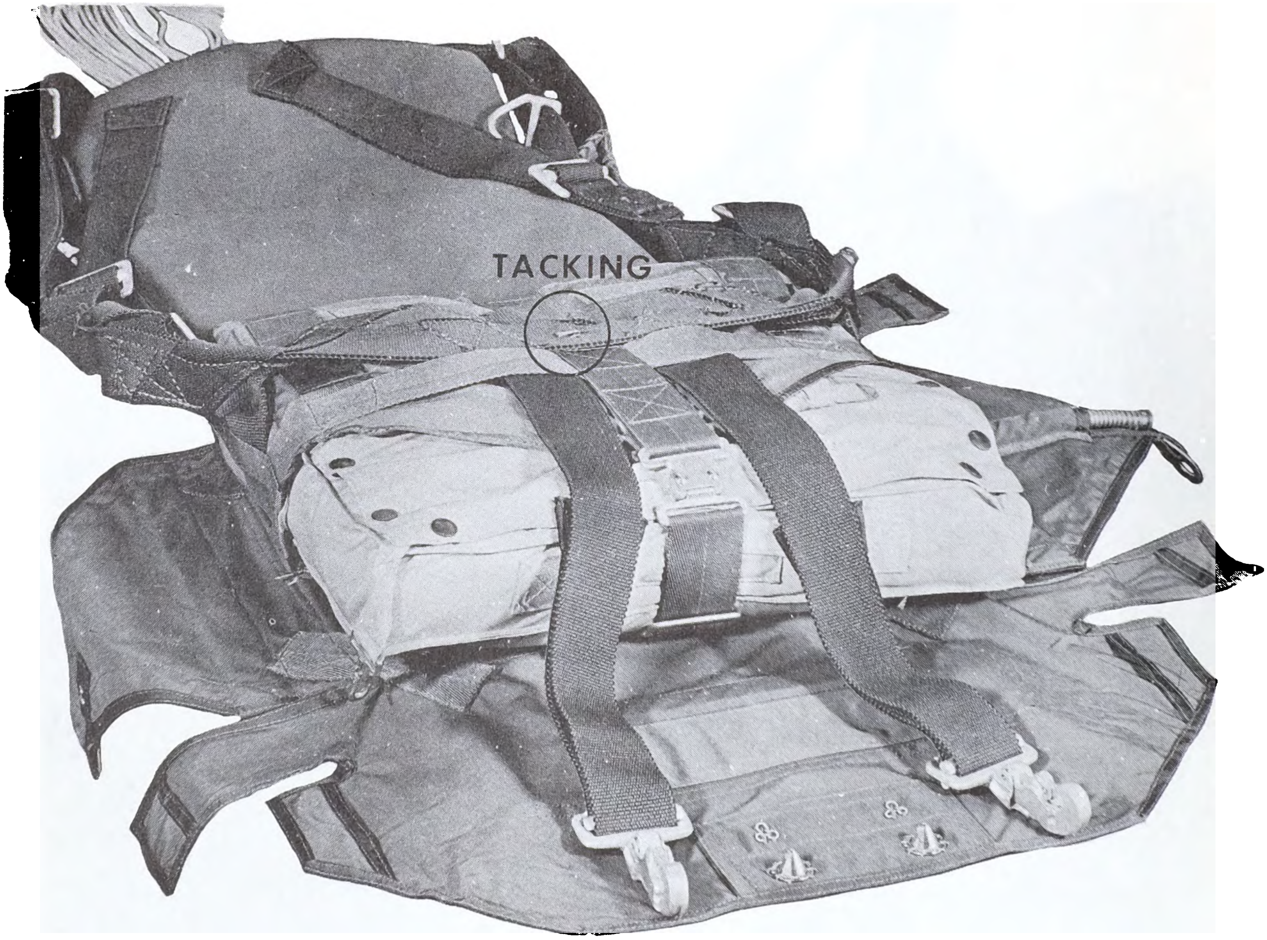


Figure 6-15.—Leg straps passed and centerline of main sling tacked to pararaft kit container. Releasing device fastened.

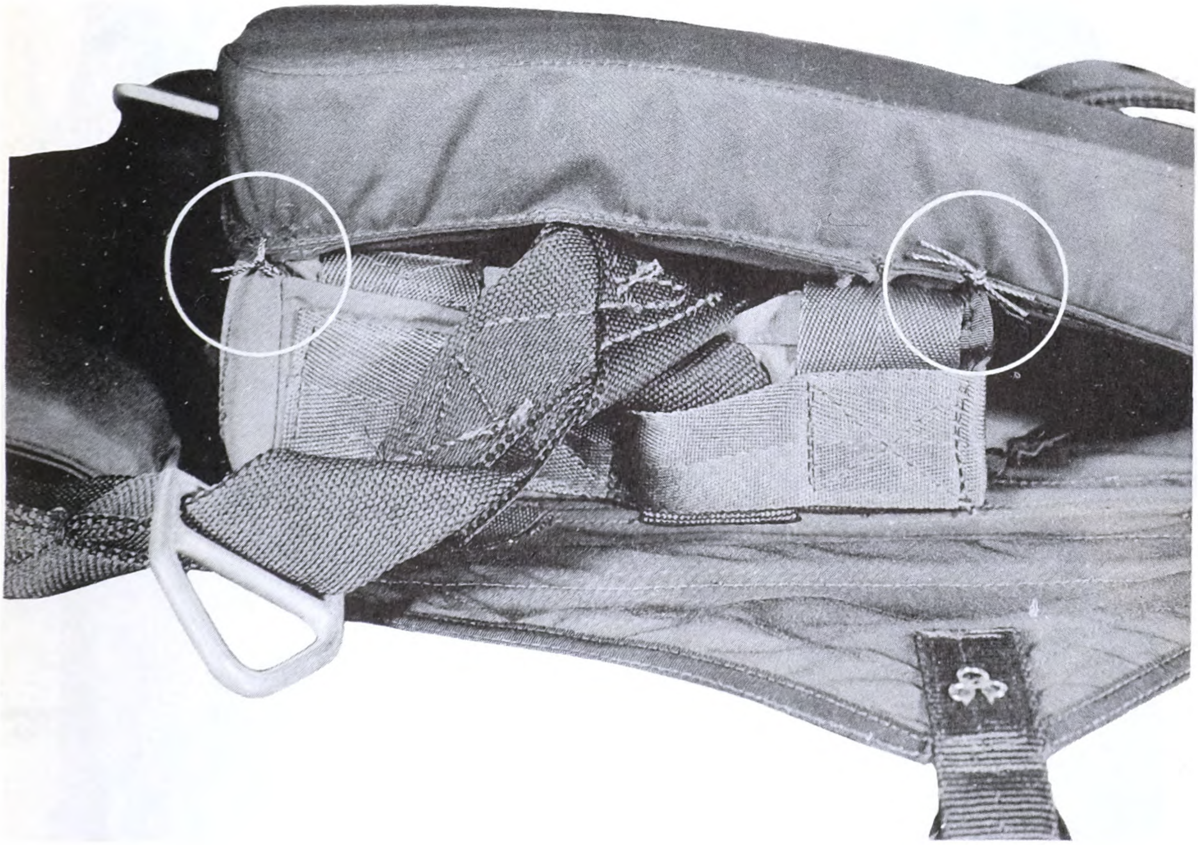


Figure 6-16.—Seat cushion side tackings.

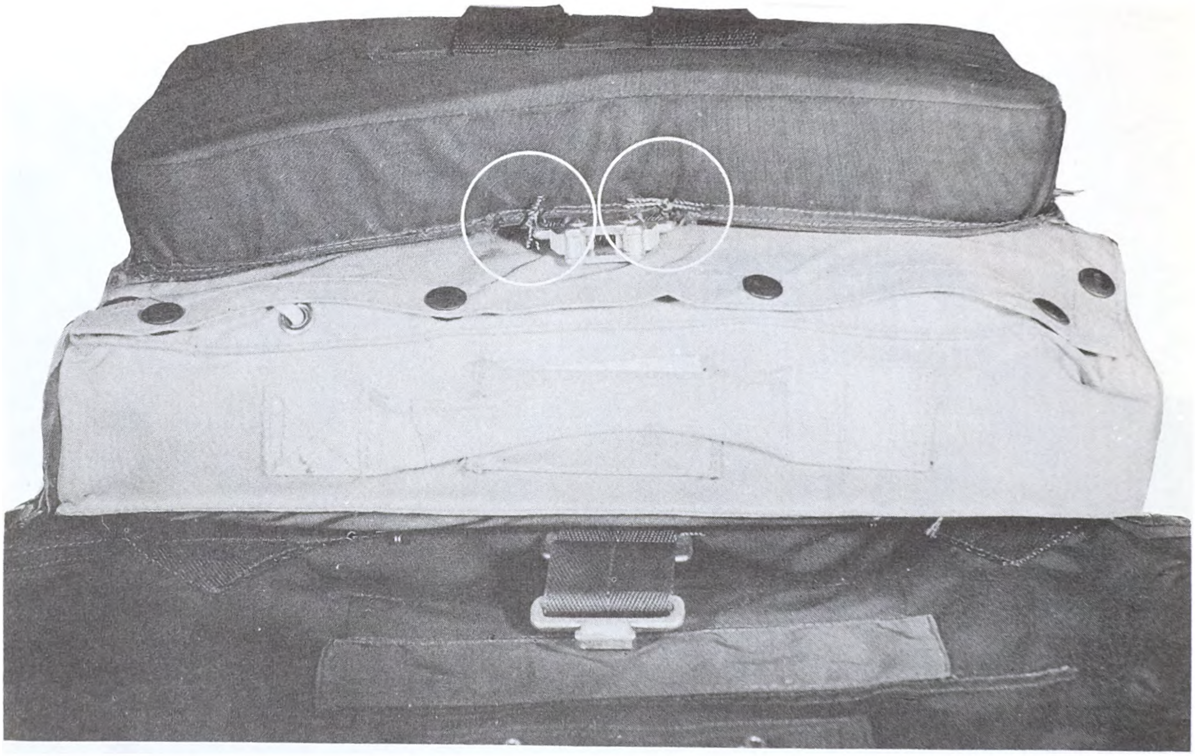


Figure 6-17.—Forward seat cushion tackings.

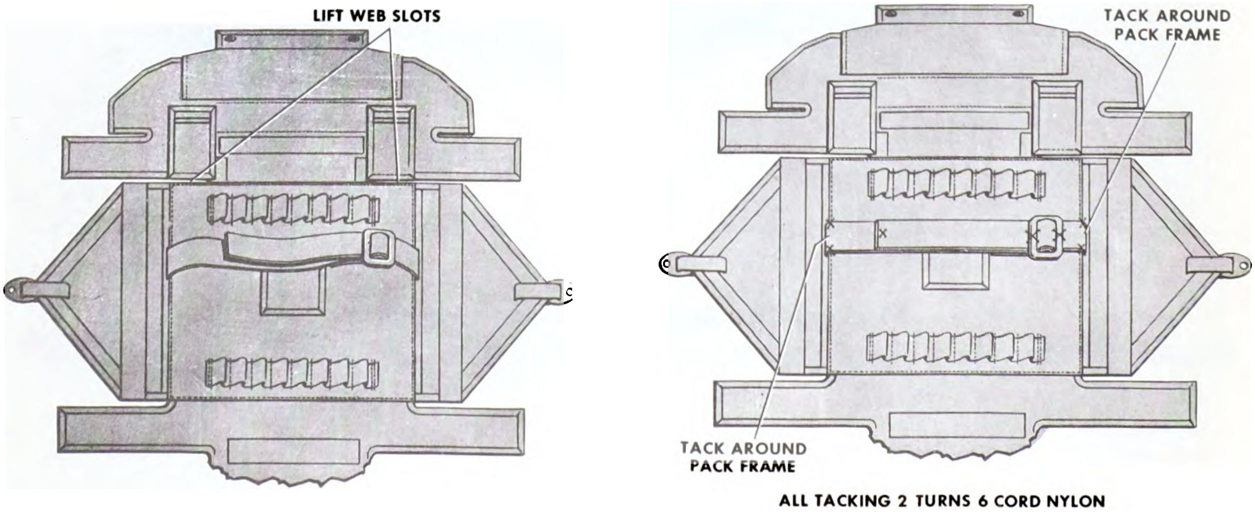


Figure 6-18.—Method of securing harness to pack. (A) Retainers entered into pack; (B) retainers drawn up and secured.

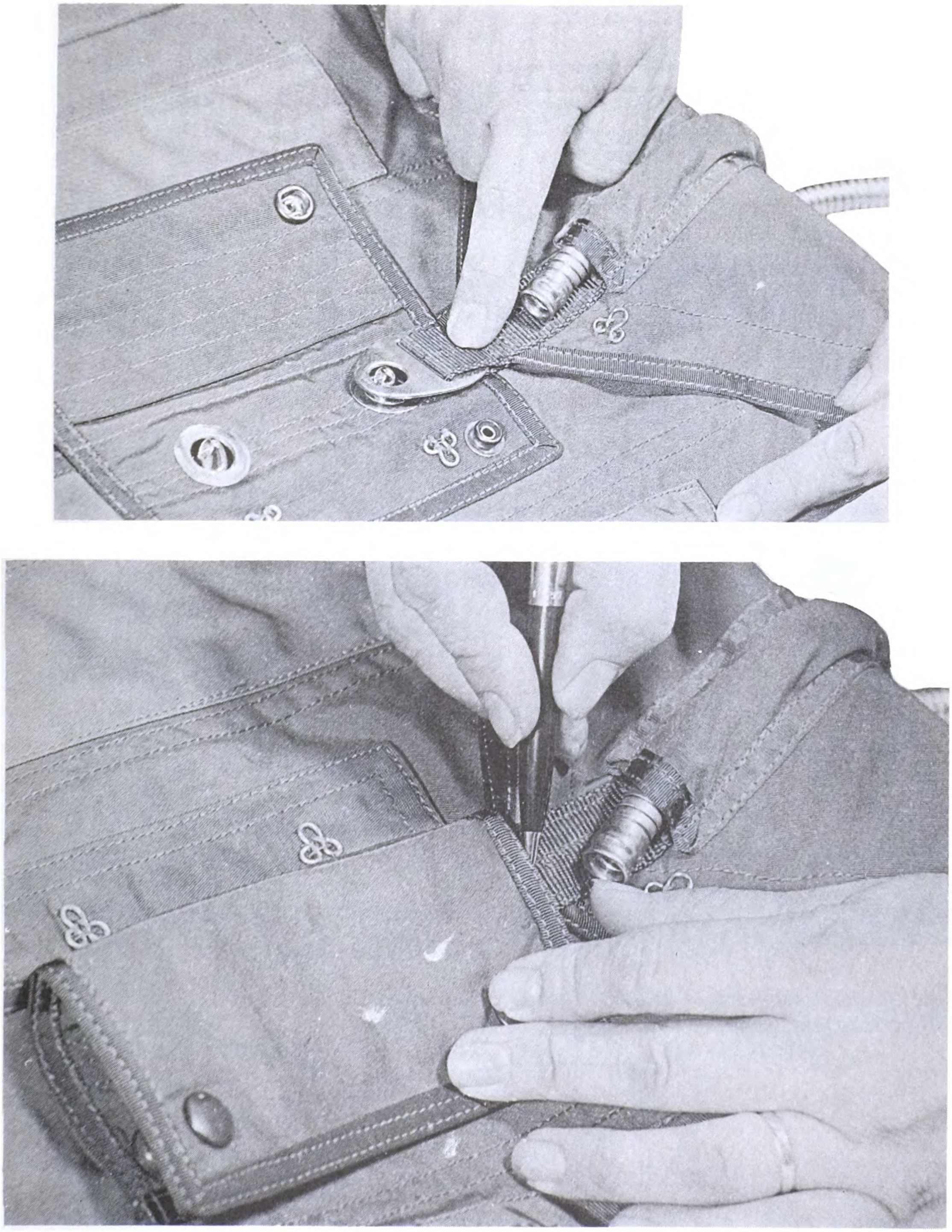


Figure 6-19.—Making a reference point for the location of the ripcord housing. (A) End tab placed over cone; (B) flap in position.

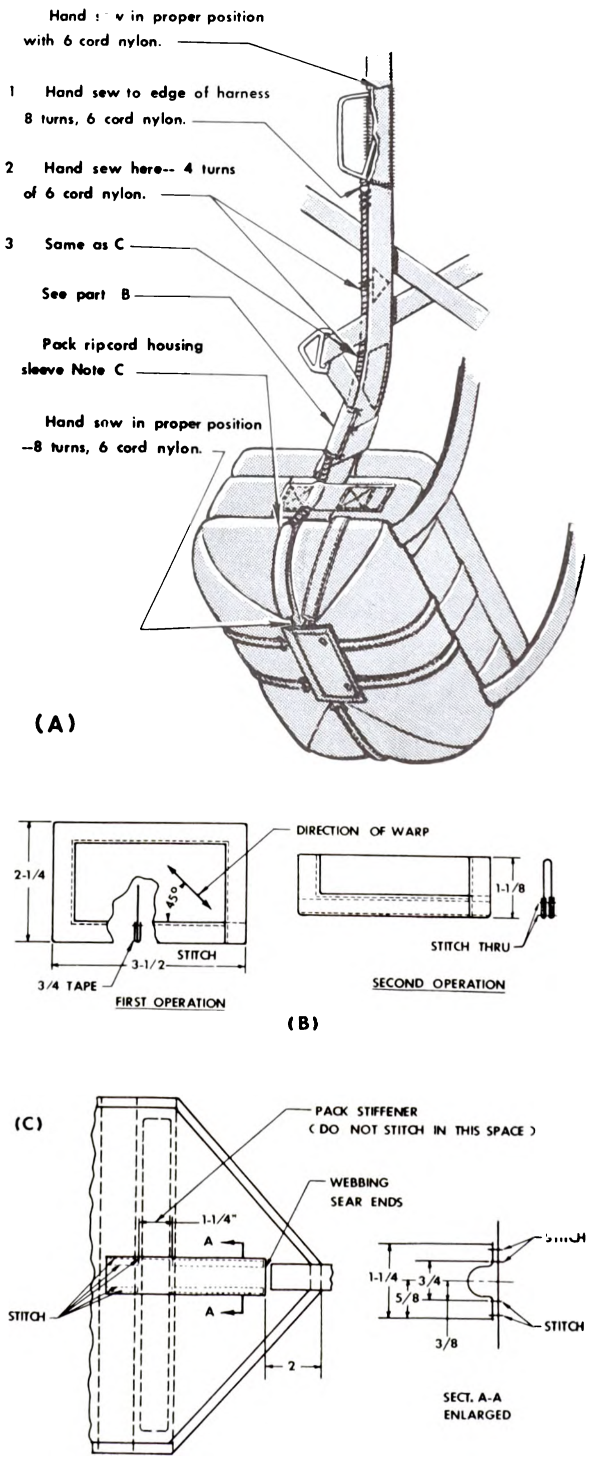

Hand sew in proper position with 6 cord nylon.
1 Hand sew to edge of harness 8 turns, 6 cord nylon.
2 Hand sew here-- 4 turns of 6 cord nylon.
3 Same as C
See part B
Pack ripcord housing sleeve Note C
Hand sew in proper position --8 turns, 6 cord nylon.
(A)
2-1/4
45°
DIRECTION OF WARP
STITCH
3-1/2
3/4 TAPE
FIRST OPERATION
1-1/8
STITCH THRU
SECOND OPERATION
(B)
(C)
PACK STIFFENER
(DO NOT STITCH IN THIS SPACE)
WEBBING
SEAR ENDS
1-1/4"
A
A
STITCH
2
STITCH
1-1/4
3/4
5/8
3/8
STITCH
SECT. A-A
ENLARGED

Figure 6-20.—Attachment of ripcord housing to seat type pack.

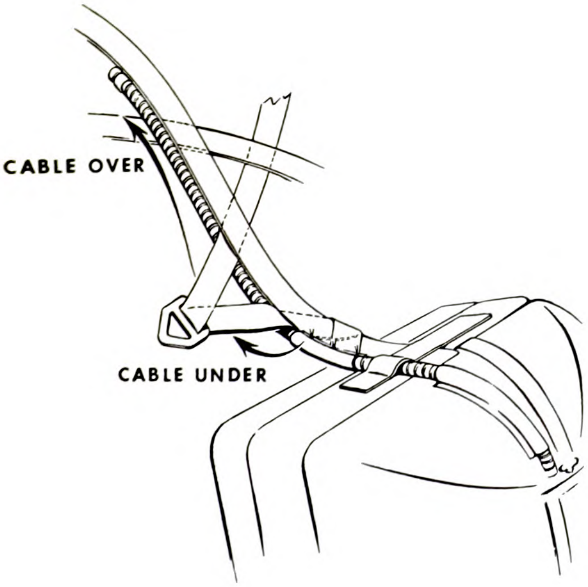


Figure 6-21.—Housing passage through harness sleeve.

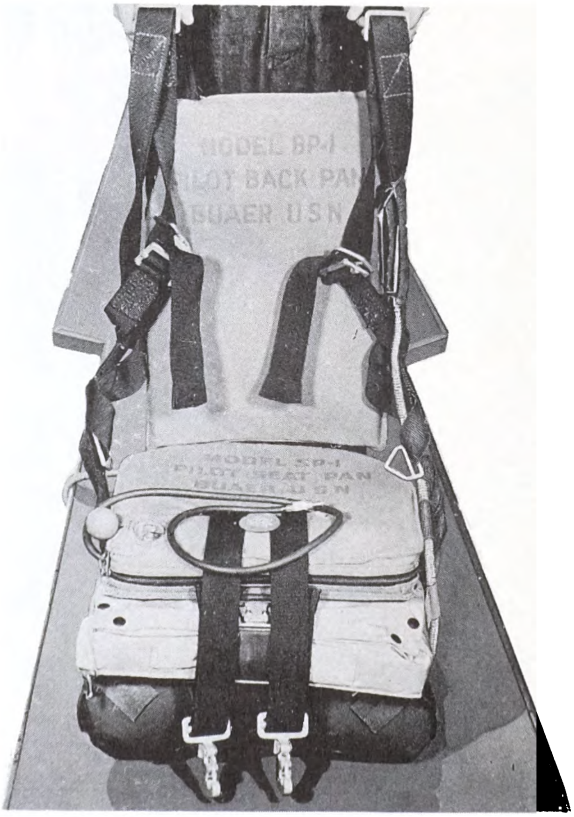


Figure 6-22.—H-2 emergency bailout cylinder installed in seat pan on the seat type parachute.

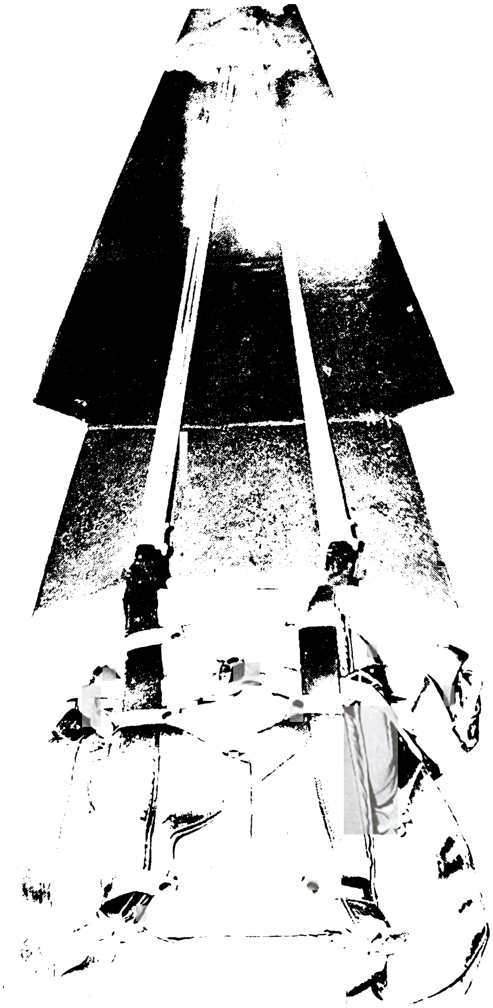


Figure 6-23.—Seat type parachute under tension.

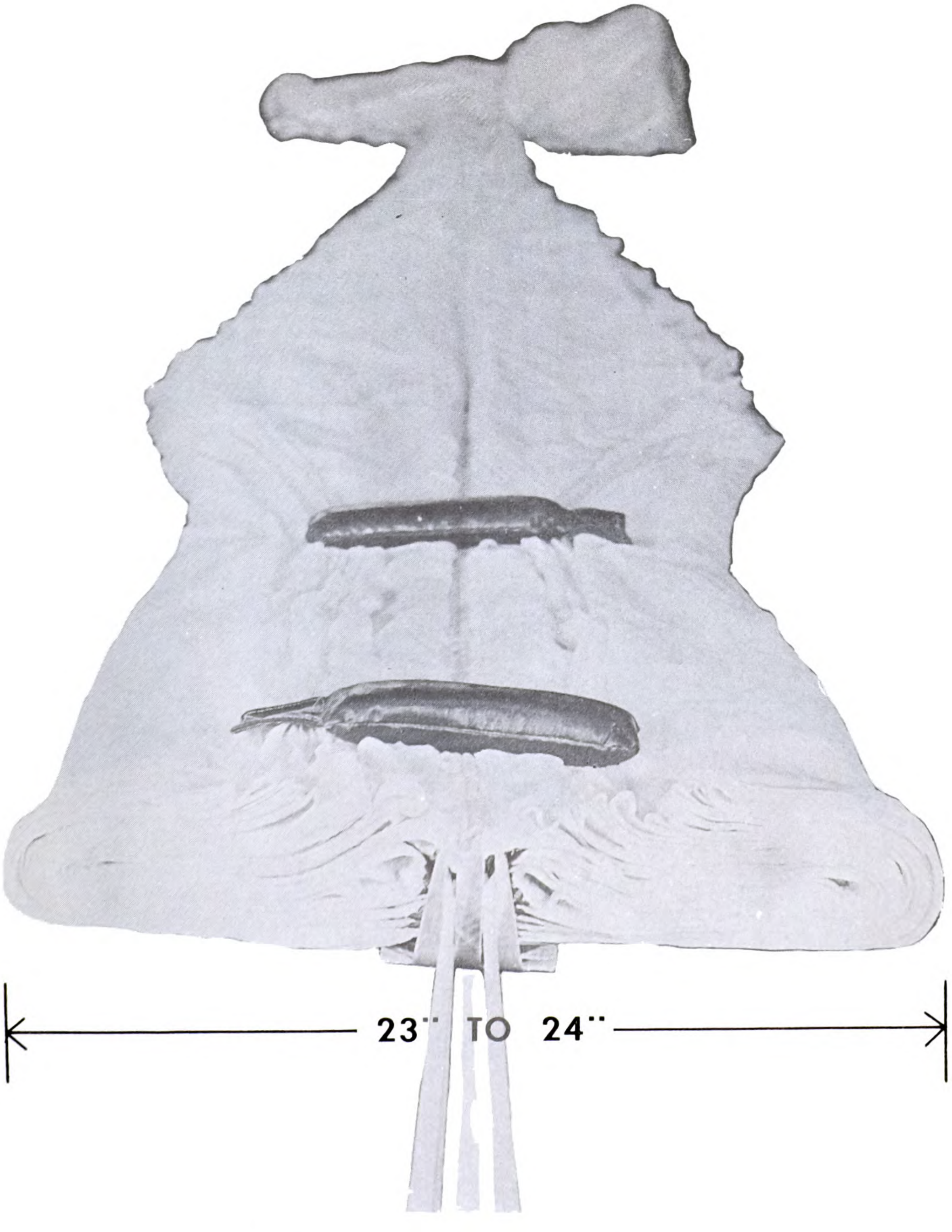


Figure 6-24.—Folded width, 23 to 24 inches.

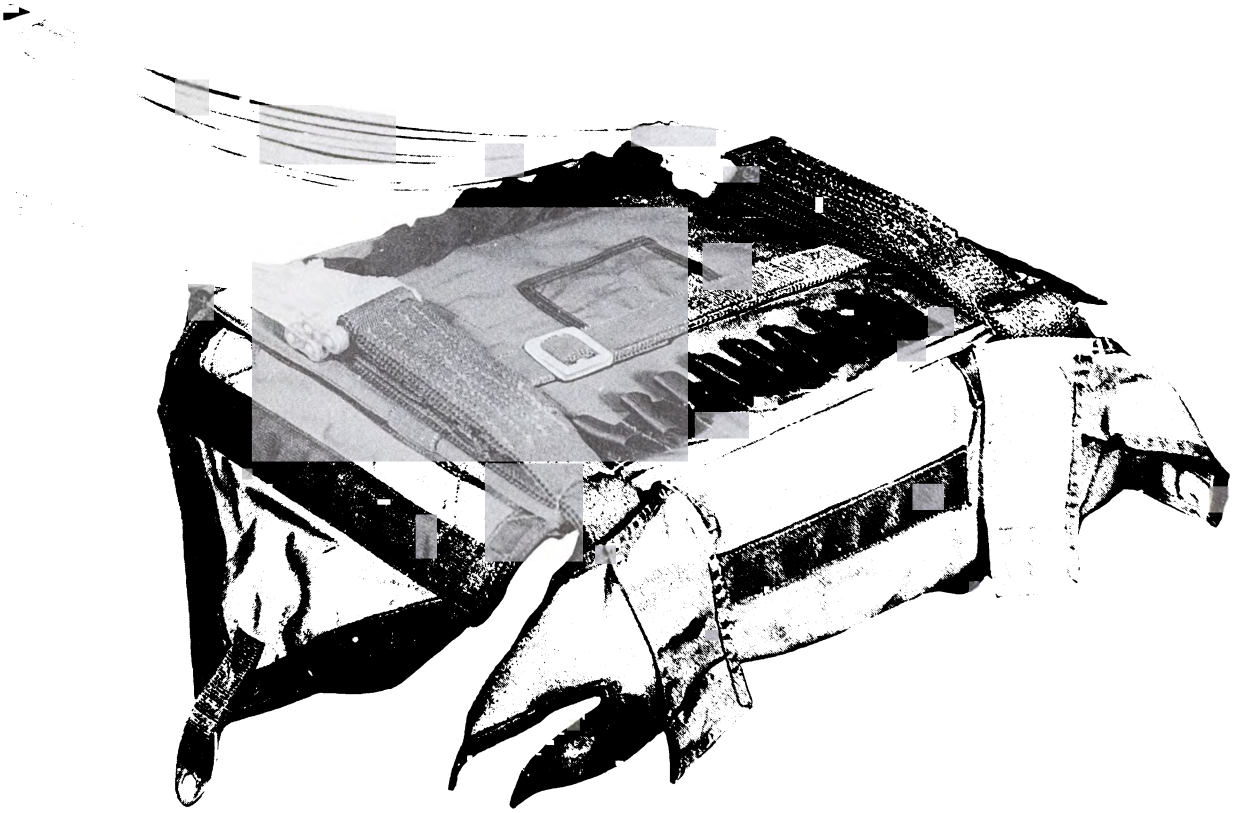


Figure 6-25.—Harness and pack sides folded and placed under pack.

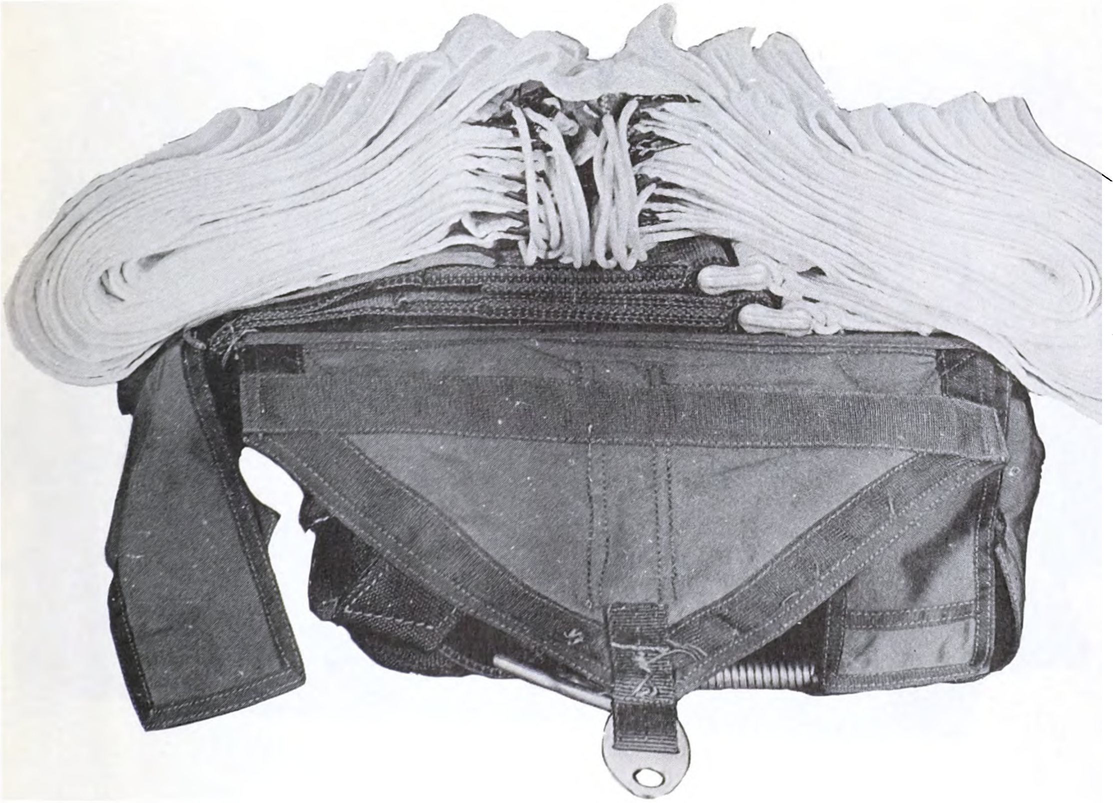


Figure 6-26.—Canopy in position on pack.

Figure 6-27.—Bottom rear fold extending beyond end of pack.

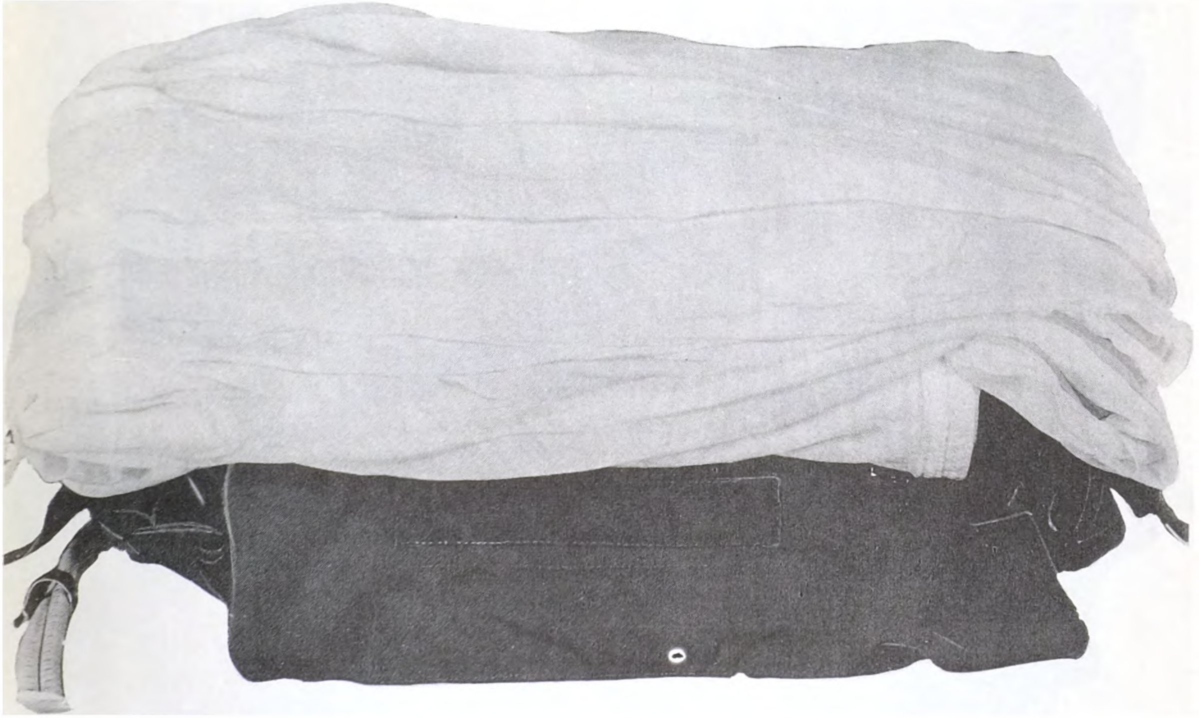


Figure 6-28.—The remaining folds placed on the pack.

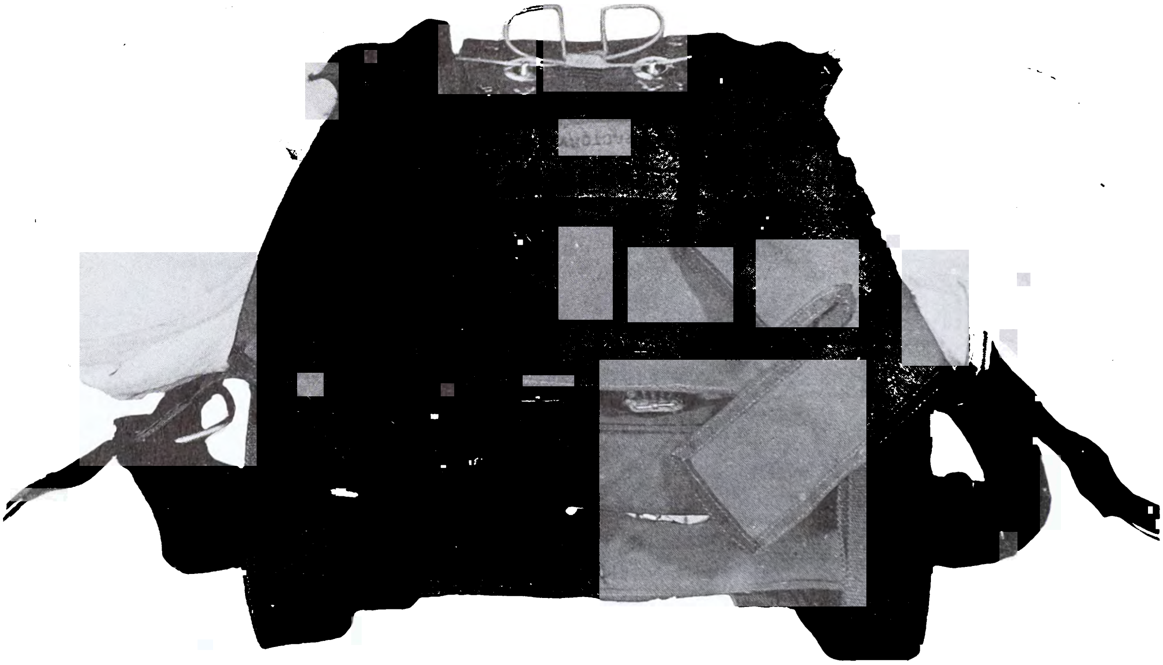
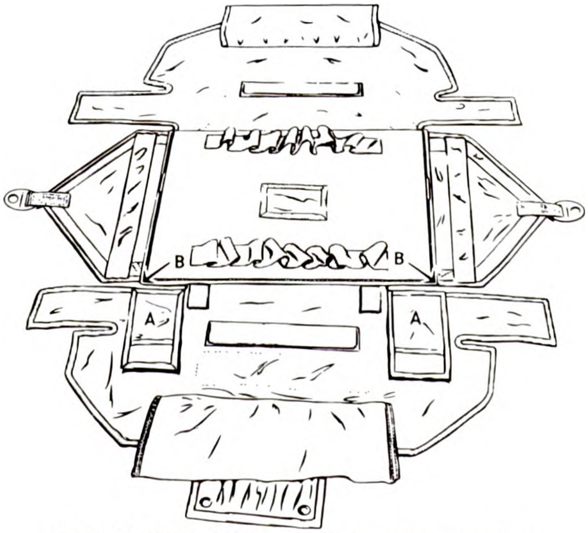


Figure 6-29.—Pack partially closed.



FLAPS 'A' HAVE BEEN SHIFTED TO APPROXIMATELY 3/8" BEYOND POINTS 'B' INDICATED BY ARROWS

Figure 6-30.—Repositioning lift web protector flaps to prevent flat packed canopy from showing.

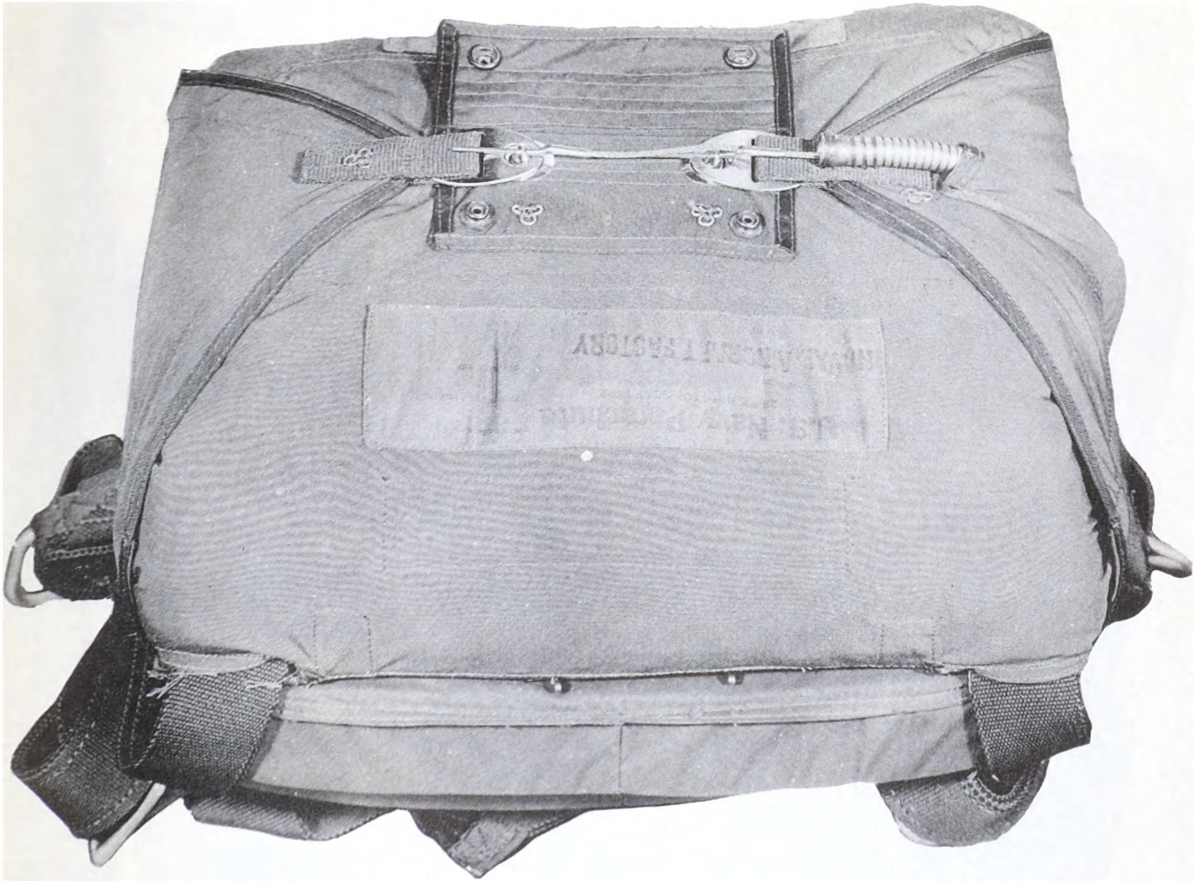


Figure 6-31.—Ripcord locking pins inserted.

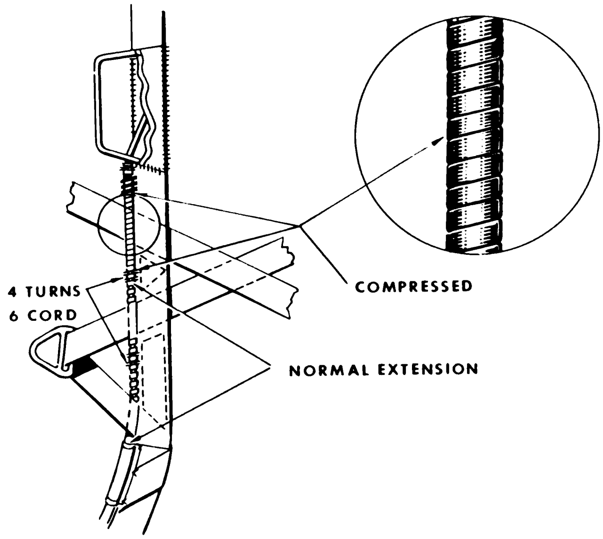


Figure 6-32.—Ripcord housing and handgrip pocket tackings for seat type parachute without pararaft.

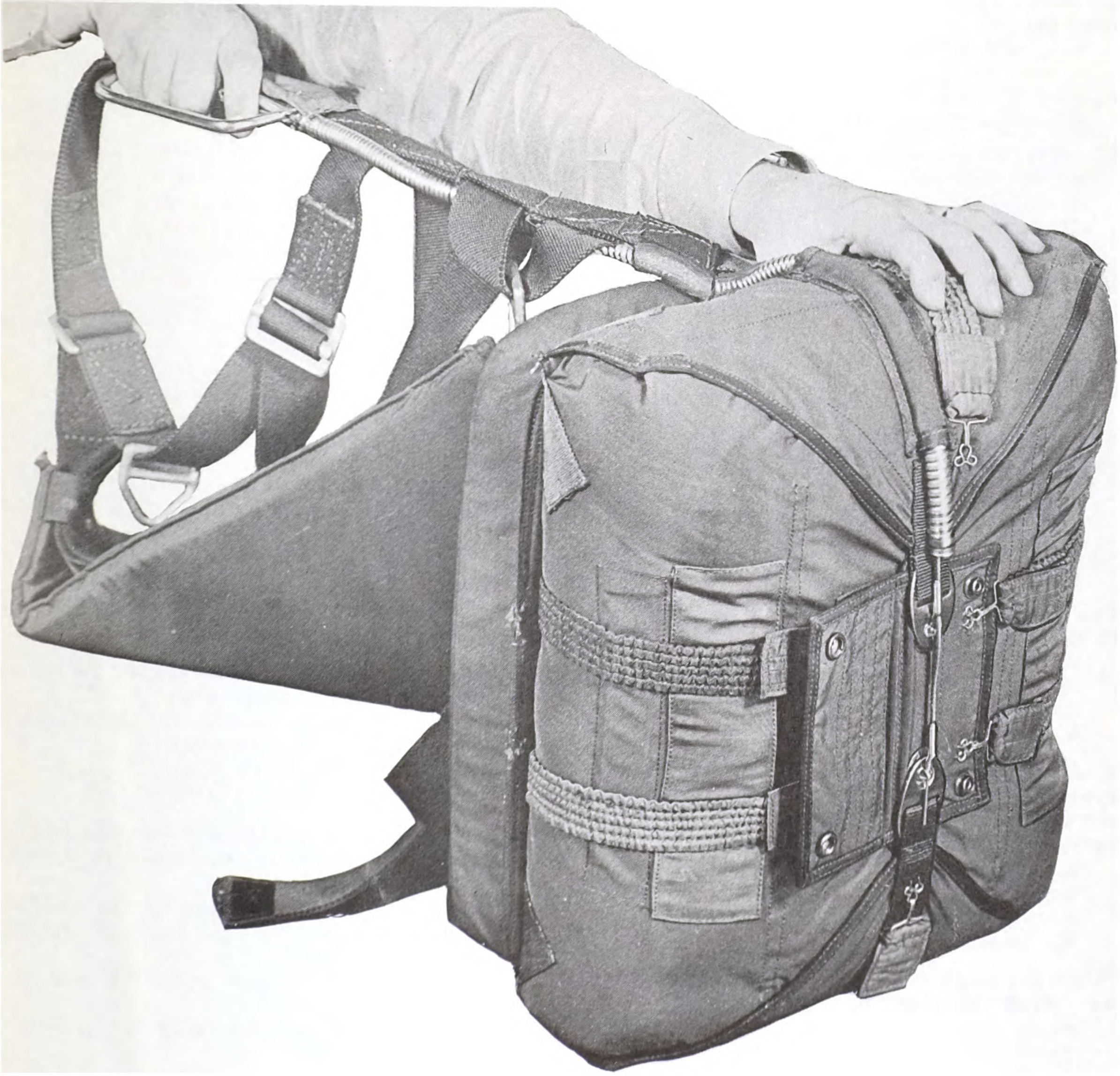


Figure 6-33.—Checking parachute for susceptibility of premature opening.

QUIZ

1. The parts of the harness that the connector links are attached to are the
    a. chest straps
    b. leg straps
    c. lift webs
    d. cross straps
2. All tackings are tied off with a
    a. bowline knot
    b. square knot
    c. clove hitch
    d. surgeon's knot
3. When rigging the NS-3 parachute, the retainer strap is tacked in ___ places.
    a. 2
    b. 4
    c. 5
    d. 7
4. When rigging the NS-3 parachute, the retainer strap is tacked around the pack frame in ___ places.
    a. 2
    b. 4
    c. 7
    d. 9
5. The thread used to tack the retainer strap to the container on the NS-3 parachute is
    a. E thread, single, two turns
    b. E thread, double, two turns
    c. 6-cord, single, two turns
    d. 6-cord, double, two turns
6. When attaching the ripcord housing to the harness of the NS-3 parachute, without the pararaft kit container, the housing is tacked between the first and second tacking and is
    a. relaxed
    b. compressed
    c. extended
    d. twisted
7. When rigging the NS-3 parachute, the retainer strap adapter is tacked in ___ places.
    a. 2
    b. 4
    c. 7
    d. 8
8. The first tacking on the NS-3 ripcord housing is
    a. 4 turns, 6-cord nylon, double
    b. 4 turns, 6-cord nylon, single
    c. 8 turns, 6-cord nylon, double
    d. 8 turns, 6-cord nylon, single
9. The type of thread used to tack the lift webs of the NS-3 parachute is
    a. 1 turn, A double
    b. 2 turns, A single
    c. 1 turn, E double
    d. 2 turns, E single
10. On the NS-3 harness, the extensible type ripcord housing is tacked in ___ places.
    a. 2
    b. 3
    c. 4
    d. 5
11. The seat cushion on the NS-3 parachute is tacked on each corner with
    a. 1 turn, E thread double
    b. 2 turns, E thread single
    c. 1 turn, 6-cord double
    d. 2 turns, 6-cord single
12. When rigging the NS-3 parachute, the retainer strap is tacked with
    a. 2 turns, 6-cord single
    b. 1 turn, 6-cord double
    c. 2 turns, E thread, single
    d. 2 turns, 3-cord single
13. When flat packing, the folds of the canopy should overlap the sides of the container ___ inches.
    a. 1 to 2
    b. 2 to 3
    c. 3 to 4
    d. 4 to 5
14. The folded gores, when placed in the container for flat packing are
    a. the same width as the container
    b. 16 to 18 inches wide
    c. 20 to 22 inches wide
    d. 23 to 24 inches wide
15. The third and subsequent folds of the NS-3 parachute canopy are stowed in the container on the ripcord end
    a. even with the end of the container
    b. the same as the canopy on the NC-3 parachute
    c. 2 to 3 inches over the end of the container.
    d. 3 to 4 inches over the end of the container
16. When flat packing the NS-3 parachute, all folds on the end opposite the ripcord end will extend over the end of the container
    a. 0 to 1 inch
    b. 1 to 2 inches
    c. 2 to 3 inches
    d. 3 to 4 inches
17. The name plate on a NS-3 canopy is stenciled on gore number
    a. 1
    b. 14
    c. 24
    d. 28

18. **When rigging the NS-3 parachute with the pararaft, the pararaft kit container is tacked to**
    - a. the parachute container
    - b. a seat cushion
    - c. both of the above
    - d. neither of the above
19. **The seat cushion is tacked to the pararaft kit container in___places.**
    - a. 3
    - b. 4
    - c. 5
    - d. 6
20. **The pararaft kit container is tacked to the NS-3 parachute container at each point with**
    - a. 1 turn, E thread, nylon, double
    - b. 1 turn, 3- or 6-cord nylon, double
    - c. 1 turn, 3- or 6-cord nylon, single
    - d. 2 turns, 3- or 6-cord nylon, single
21. **To tack the seat cushion to the pararaft kit container, use 3- or 6-cord nylon**
    - a. 1 turn, single
    - b. 1 turn, double
    - c. 2 turns, double
    - d. 2 turns, single
22. The housing between the second and third tackings on a seat type parachute, with the pararaft being used, should be
    - a. compressed
    - b. extended
    - c. relaxed
    - d. natural
23. When packing the NS-3, the next step after whipping and folding the canopy is to
    - a. stow the canopy
    - b. sign the Parachute Record Card
    - c. stow the shroud lines
    - d. hook up the opening bands
24. The safety tie on the NS-3 paracute is made with___thread.
    - a. E
    - b. B
    - c. A
    - d. FF
25. When checking the NS-3 parachute for premature opening,
    - a. give the housing a pull of 50 pounds
    - b. pull the tackings under a 50-pound pull
    - c. subject the harness to a pull of 50 pounds
    - d. inspect the entire rig very carefully

CHAPTER 7

PACKING AND RIGGING BACK TYPE PARACHUTES

The Navy back (NB) type parachute is especially designed for use in high-speed aircraft. The back type parachute is positive and stable, and the pack is thin and comfortable to the wearer. The many modifications and capabilities of this parachute make it a very useful item of survival equipment.

Parachutes of this general design are the NB-3, NB-5, NB-6, NB-7, NB-8, and NB-9. Another back type parachute, but having no NB designator, is the Martin-Baker.

The NB-3, NB-6, and NB-8 are used with the standard harness. The NB-5, NB-7, NB-9, and the Martin-Baker are used with the integrated harness. The harness combines the lap belt and harness into an integrated assembly and forms a part of an ejection seat escape system. By installing an automatic parachute actuator (ch. 10), all of the back type parachutes can be used with an ejection seat.

In order to avoid a great deal of repetition, yet cover the procedure for packing and rigging the maximum number of back type parachutes (both with and without the integrated harness), this chapter describes and illustrates rigging of the NB-3 and packing of the NB-6 and NB-8, chapter 8 deals entirely with the Martin-Baker, and chapter 9 with the NB-9.

RIGGING THE BACK TYPE PARACHUTE

Packing and rigging procedures for the back, chest, and seat type parachutes are similar in most respects. Since the differences in the major components of the assemblies are known to you, packing and rigging the standard back type parachute should be quite simple.

Rigging Without Pararaft

The step-by-step procedure for rigging without the pararaft follows:

1. Clean the table.
2. Lay out the tools and equipment.
3. Lay out the parachute. The rigging diagram for the back type parachute is shown in figure 7-1.

Attach the pack to the harness. (see fig. 7-2.)

Attach the ripcord housing to the pack and the grip pocket. Do not secure the pocket to the harness with top and bottom tackings until after packing the parachute. Attach the wing straps of the pack to the harness. Secure the pararaft retaining straps. (See fig. 7-1.)

A back type cushion, which has been developed for universal use (shown in fig. 7-3) on service type parachute, must be used. The cushion is installed on the body side of the harness in a manner similar to the installation on the seat type, except that the lift web keepers are not used but are snapped in place to avoid entanglement.

The cushion is tacked with 6-cord nylon in four places close to the corners. These tackings pass completely through the container or pack and must be made while the parachute is in an unpacked condition. The two tackings at the top end must also go through the container and the type XVII webbing (fig. 7-1 (A) to aid in giving rigidity to the assembly. Tack the lift webs with one turn of size E nylon thread, doubled, to the top edge of the pack.

4. When rigging procedures are begun with a completely unrigged parachute, many of the inspecting and repair procedures will be closely combined with the rigging procedures. It is very difficult to know exactly when to draw the line to show where inspection and repair methods stop and rigging procedures begin, as they are closely linked. The best rule to follow is: ALWAYS INSPECT AND REPAIR, IF NECESSARY, EACH AND EVERY ASSEMBLY BEFORE ATTACHING IT TO THE PARACHUTE.

5. Hook up the parachute. Figure 7-3 illustrates a method of engaging the parachute under tension. The parachute is laid out and held under tension with the harness in the body position of a man lying face up on the table, his head toward the canopy.

6. Whip and fold the canopy. This procedure is the same as for the chest type parachute, except that the final folded width of the canopy

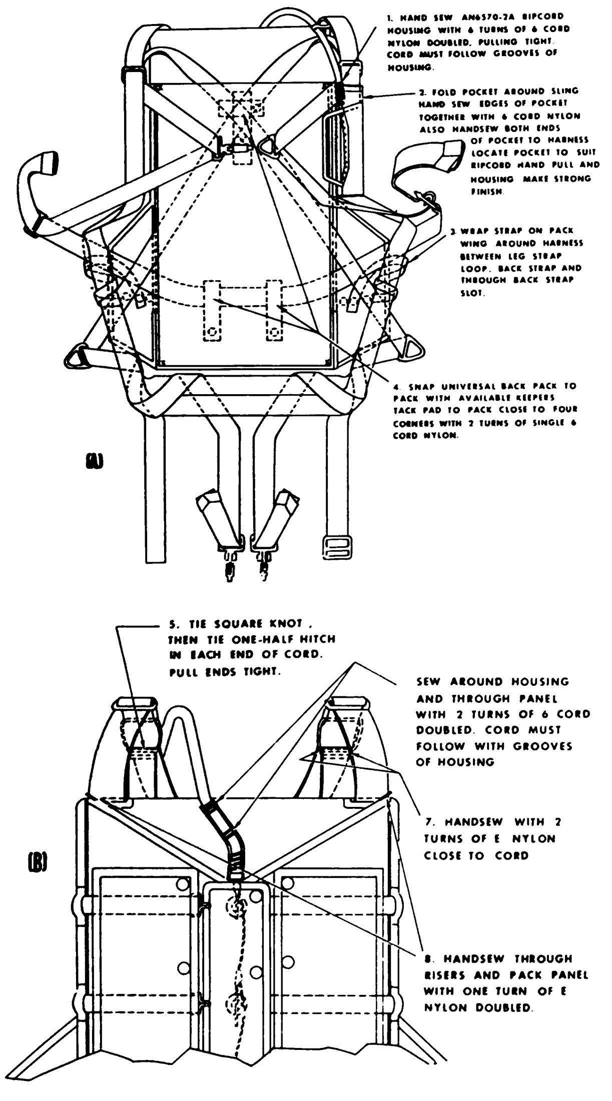

1. HAND SEW AN6570-2A RIPCORD HOUSING WITH 6 TURNS OF 6 CORD NYLON DOUBLED. PULLING TIGHT. CORD MUST FOLLOW GROOVES OF HOUSING.
2. FOLD POCKET AROUND SLING HAND SEW EDGES OF POCKET TOGETHER WITH 6 CORD NYLON ALSO HANDSEW BOTH ENDS OF POCKET TO HARNESS LOCATE POCKET TO SUIT RIPCORD HAND PULL AND HOUSING MAKE STRONG FINISH.
3. WRAP STRAP ON PACK WING AROUND HARNESS BETWEEN LEG STRAP LOOP. BACK STRAP AND THROUGH BACK STRAP SLOT.
4. SNAP UNIVERSAL BACK PACK TO PACK WITH AVAILABLE KEEPERS TACK PAD TO PACK CLOSE TO FOUR CORNERS WITH 2 TURNS OF SINGLE 6 CORD NYLON.
(A)
5. TIE SQUARE KNOT, THEN TIE ONE-HALF HITCH IN EACH END OF CORD. PULL ENDS TIGHT.
SEW AROUND HOUSING AND THROUGH PANEL WITH 2 TURNS OF 6 CORD DOUBLED. CORD MUST FOLLOW WITH GROOVES OF HOUSING
7. HANDSEW WITH 2 TURNS OF E NYLON CLOSE TO CORD
8. HANDSEW THROUGH RISERS AND PACK PANEL WITH ONE TURN OF E NYLON DOUBLED.
(B)

Figure 7-1.—Rigging diagram for the back type parachute.

should conform to the width of the back pack which is wider than the chest pack.

7. Unhook, tack the links over the second frame from the bottom, using one turn of size E nylon thread for each two links, and sign the inside Parachute Record Card.

8. Insert suspension lines in the pack. Insert lines in the first hesitator loop as shown in figure 7-4. All but approximately 18 inches of the suspension line length is stowed through the hesitator loops. (See fig. 7-5.) The skirt is ready to be brought up on the pack.

9. Place canopy on pack. With the pack still in the same position lift the skirt and move it up to the opposite end of the pack. This is the top edge of the pack. The canopy is accordion folded on the container, as described in chapter 5 for the chest type parachute. Since the back type parachute pack is longer than the chest type, not as many folds will be required to completely fold the canopy.

10. Position the pilot chute and prepare to close the pack.

11. While holding the pilot chute compressed and in place, bring up the side flaps and insert two temporary locking pins in the center locking cones to hold the sides closed. The pack may be turned or left lying parallel to the table's length while the sides are being brought up and secured. (See fig. 7-6.)

Straighten the canopy fabric and insert the locking cone located on the top end flap through the corresponding pack grommet as shown in figure 7-7, then insert the top ripcord pin.

12. Remove the temporary locking pins as the remaining ripcord pins are inserted in the locking cones. The bottom end flap contains the last locking cone which is passed through the bottom grommet of the pack and secured by the last ripcord pin. Insert the ripcord grip in its pocket. Straighten the end flaps of the pack, using a fid. Fasten the corner snaps. (See fig. 7-8.)

13. Safety-tie the last, or bottom, ripcord pin.

14. Hook up the opening bands and fasten the ripcord protector flap.

15. Slide the ripcord pocket along the harness to the position indicated in the rigging diagram. (See fig. 7-1.) Grasping the ripcord pocket and harness with the fingers through the ripcord grip, jerk the harness outwardly away from the parachute pack. This will test the position of the ripcord grip pocket on the harness.

WARNING: Do not misplace the grip pocket. The proper adjustment of an inflexible ripcord to the flexible parts of a parachute is vitally important. Secure the ripcord pocket to the harness after adjustments have been made. (See fig. 7-1.)

16. Sign the Parachute Record Card and make a corresponding entry on the Parachute History Card.

ADJUSTMENTS

The principles of adjustment of the standard harness are the same regardless of the type of parachute attached. Adjust the back pack so that it is carried high on the back. This parachute is shown being properly worn in chapter 2 (fig. 2-10).

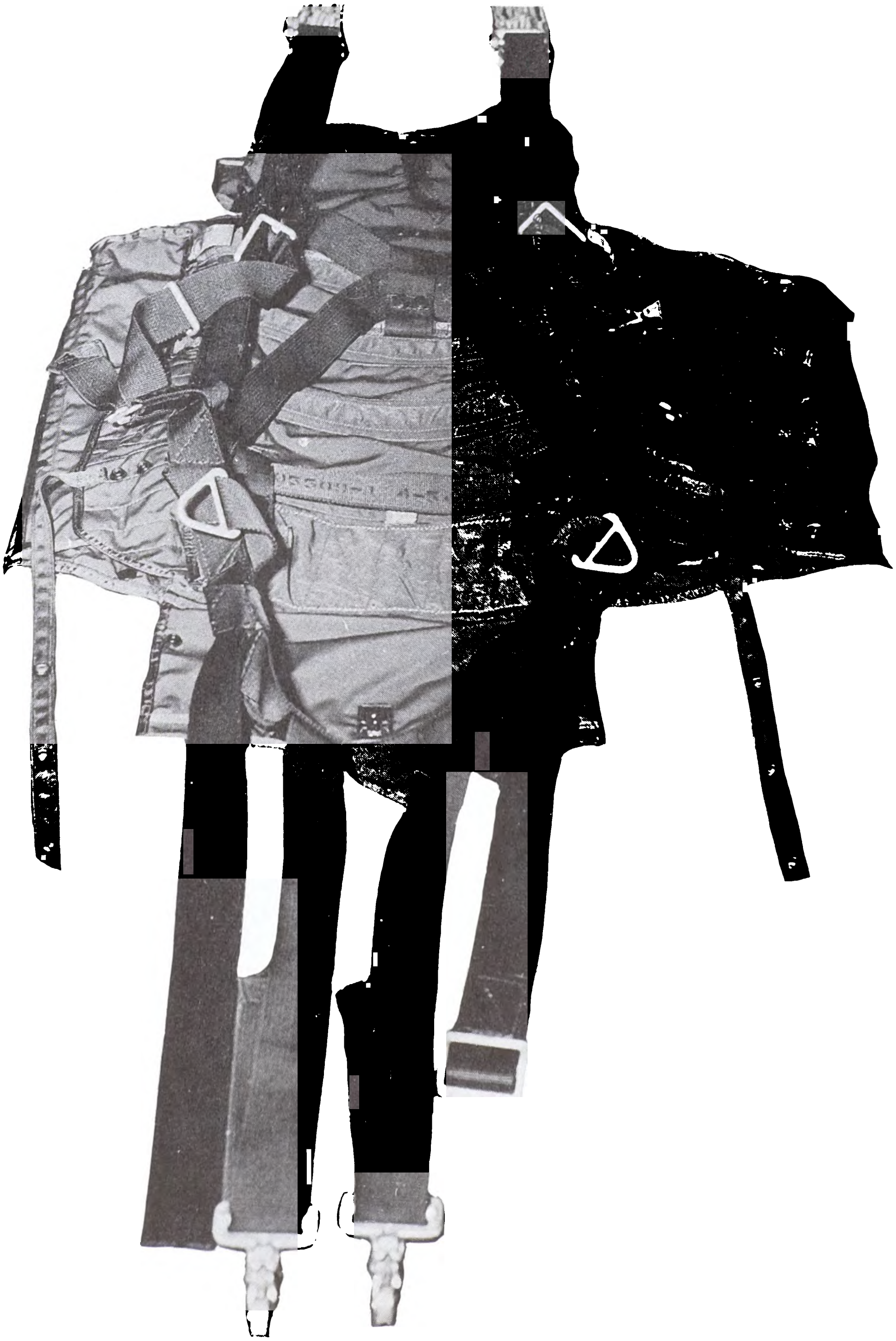


Figure 7-2.—Attachment of the back type parachute pack to the harness.

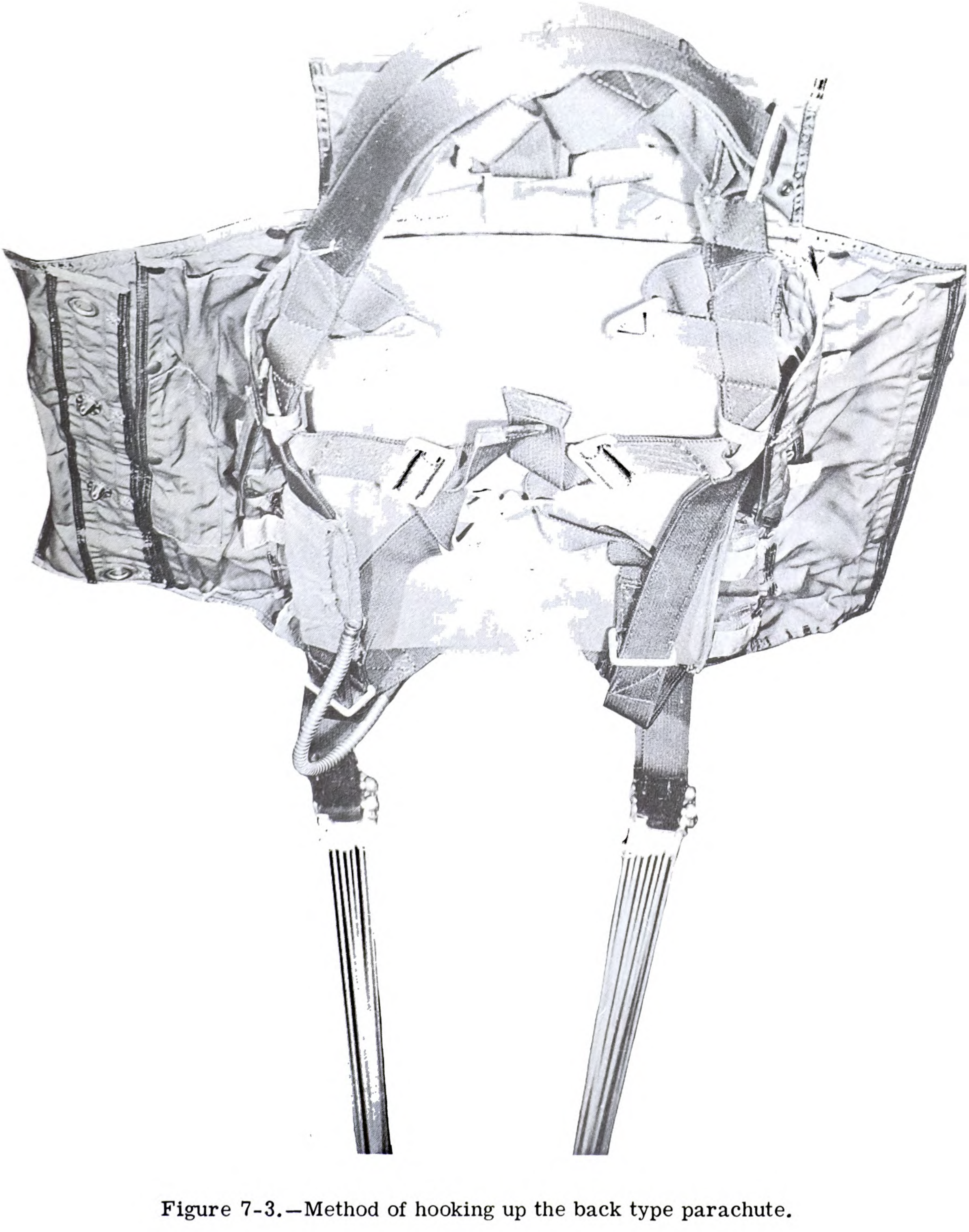


Figure 7-3.—Method of hooking up the back type parachute.

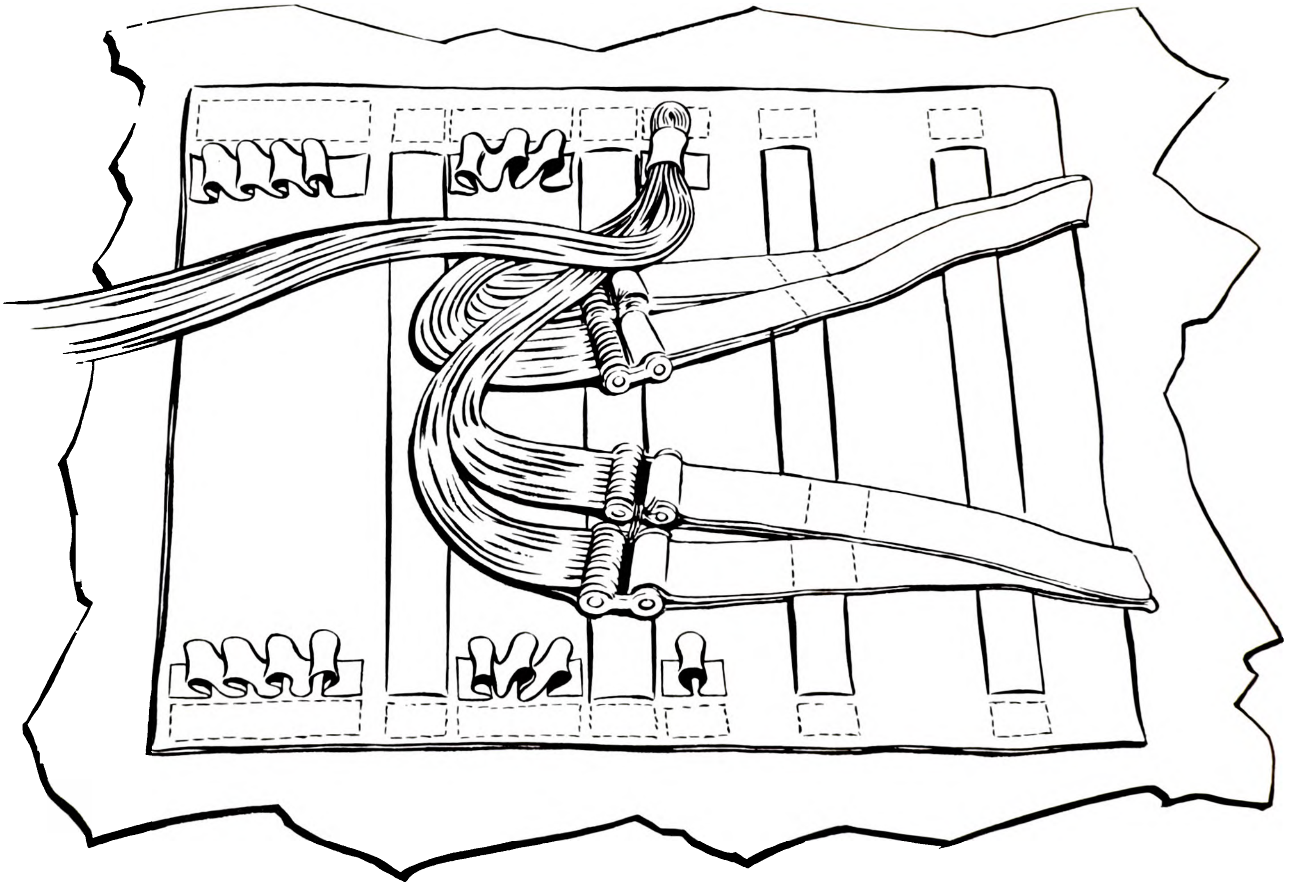


Figure 7-4.—First bight of suspension lines stowed in pack. Links of each group have been tacked down together in the center of the pack with one turn of size E nylon thread, doubled.

Figure 7-5.—Suspension lines stowed in the back pack.

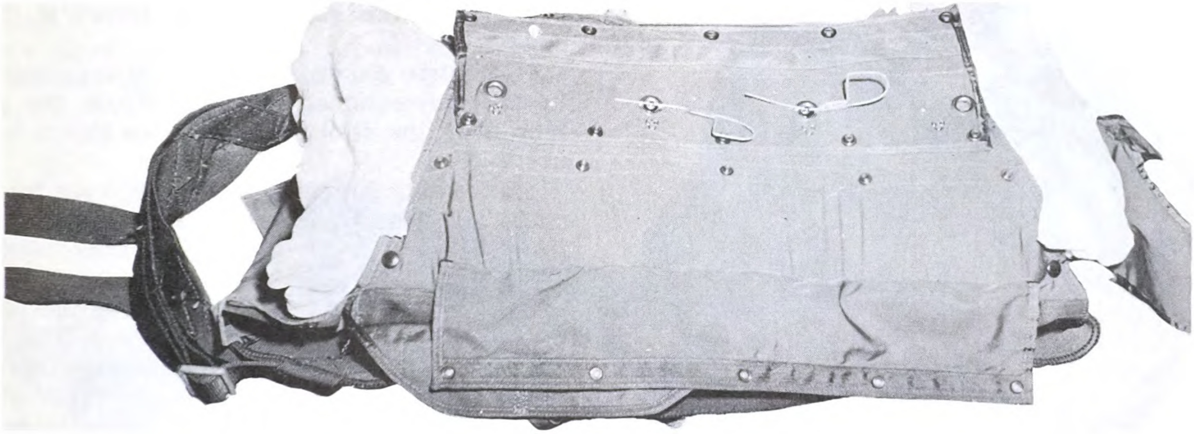


Figure 7-6.—Side flaps held by temporary locking pins.

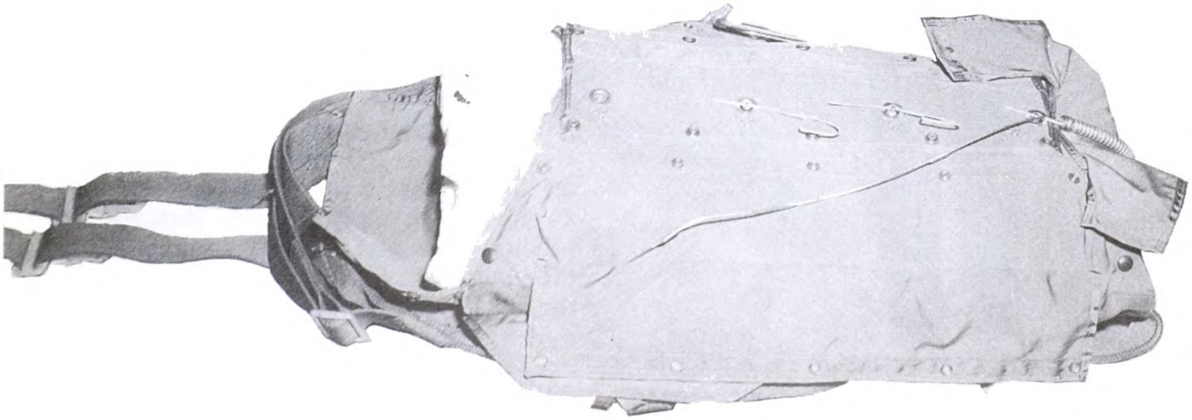


Figure 7-7.—Pack held closed by top ripcord pin and two temporary locking pins.

Rigging With the Pararaft

Rigging the back type parachute with a pararaft kit is a simple procedure in comparison with the same task on the seat type parachute. There is no ripcord replacement problem here, and the changeover can be accomplished while the parachute remains in a packed condition.

Fit the pararaft kit case to the pararaft kit container in the same manner as for the chest and seat type parachutes. Secure the adjustments with tackings. Release the pararaft retaining straps and proceed in accordance with figures 7-9 through 7-13.

PACKING THE BACK TYPE PARACHUTE

(NB-6 or NB-8)

Lay out the parachute canopy in the conventional manner. When laid out properly, the harness and container will be arranged in a manner identical to the standard procedure for assembly of the chest type parachute. The parachute is then folded in the same conventional manner as that used for the chest type parachute.

Install the automatic parachute opener in accordance with the installation instructions (ch. 10). Place the parachute container in position as illustrated in figure 7-14.

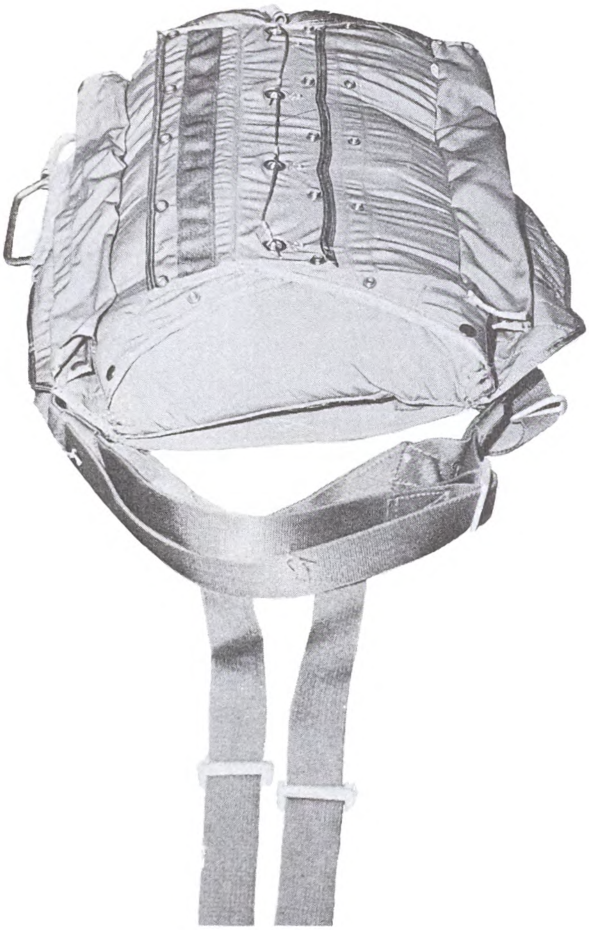


Figure 7-8.—Sides and ends of pack closed, ripcord in place.

Bring the risers over the top edge of the container, place the connector links alongside the automatic parachute opener, and hand-tack to the fabric covering the third metal stiffener from the bottom of the container. Use one turn of 3-cord nylon thread or a double turn of size FF nylon thread, as shown in figure 7-15.

Draw the suspension lines through hesitator loop No. 1, as shown in figure 7-16. When the lines are properly seated in loop No. 1 and all remaining loops, they should protrude from the loops approximately 1/2 inch.

Stow suspension lines in hesitator loops Nos. 2, 3, 4, 5, and 6, then pass the lines over the risers and stow them in loops Nos. 7, 8, 9, 10, 11. and 12. Lines will then lie in proper stowing sequence, as shown in figure 7-17.

Bring the parachute skirt to the bottom edge of the container and spread the material to the corners of the container, as shown in figure 7-18.

Complete accordion folding of the parachute in the conventional manner. Place the guide tube over the pilot chute cone, as shown in figure 7-19.

Now using the guide tube, compress the pilot chute and insert the temporary locking pin in the top hole of the pilot chute cone. Pull the nylon material away from the cone until no material is showing through the grommet. Compress the pilot chute fully and insert a temporary locking pin in the lower hole of the pilot chute locking cone, as shown in figure 7-20.

Position the pilot chute on top of the canopy in line with the second grommet from the bottom of the container, as shown in figure 7-21. Pull up the side flaps and position grommets over the pilot chute cone. Remove the pilot chute temporary locking pin and place and insert a temporary locking pin as shown in figure 7-22. Insert a temporary locking pin in the side flap cone. Close the two end flaps and insert temporary locking pins, as shown in figure 7-23.

Insert the top ripcord pin through the loop on the automatic parachute opener power cable, as shown in figure 7-24. Remove temporary locking pins and insert ripcord pins. Safety-tie the bottom ripcord pin, using size A nylon thread. Check the security of dual housing clamp screws, making sure all screws are secured properly. Close the dual housing clamp protector flap and hook up the pack opening elastics. Close the ripcord pin protector flap, secure snap fasteners on the corner tabs, insert ripcord in the pocket, and insert the Parachute Record Card in the pocket, as shown in figure 7-25.

NAVY TROOP TYPE (NT-5) PARACHUTE

The NT-5 (Navy Troop) type parachute is used as a training outfit for premeditated live descents. The outfit consists of two separate parachutes—a back type and a chest type. The back type parachute carries the harness and connecting hardware for engaging the chest type parachute.

Figures 7-26 (A) and 7-26 (B) illustrate the rigging diagram for the NT-5 back type parachute. Study these diagrams carefully as they contain all the information necessary to rig the NT-5 back type parachute.

The packing method is essentially the same as for the back type, and is therefore not repeated. When a 32-foot canopy is used, an oversize parachute pack and harness must be provided.

The chest unit of the NT-5 utilizes the 26-foot conical canopy, but the pilot chute is removed to prevent its fouling in the main canopy in the event that both parachutes have to be used during a jump. Figure 7-27 is the rigging diagram for the chest unit.

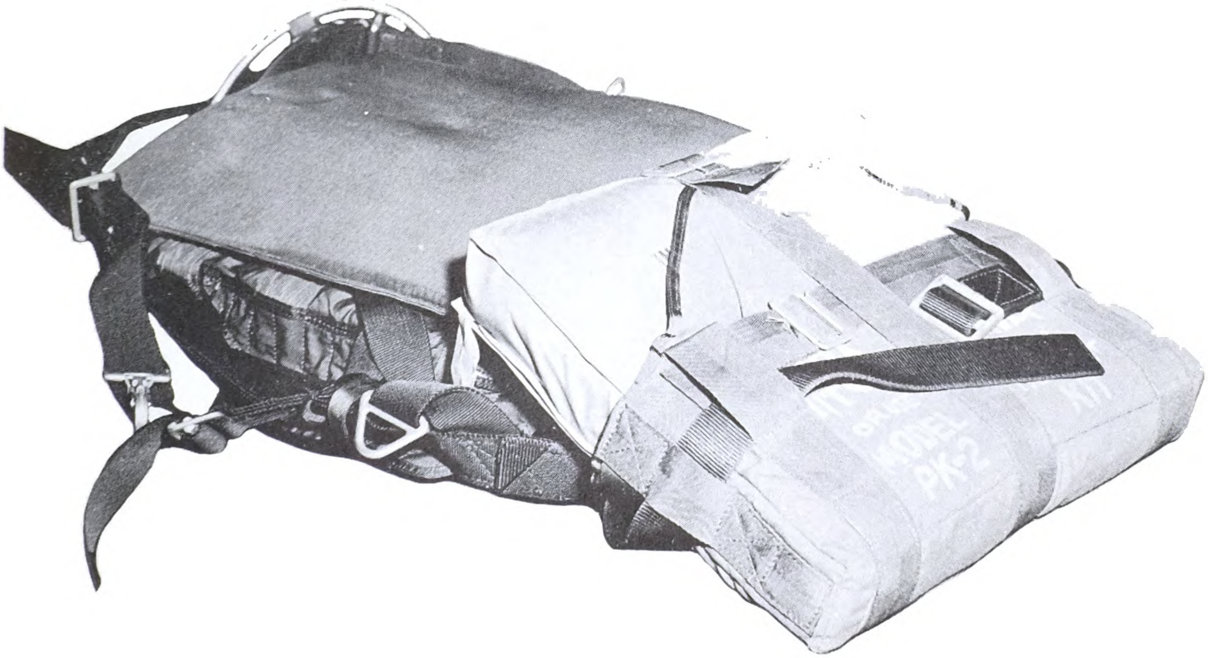


Figure 7-9.—Retaining straps passed through side and bottom keepers.

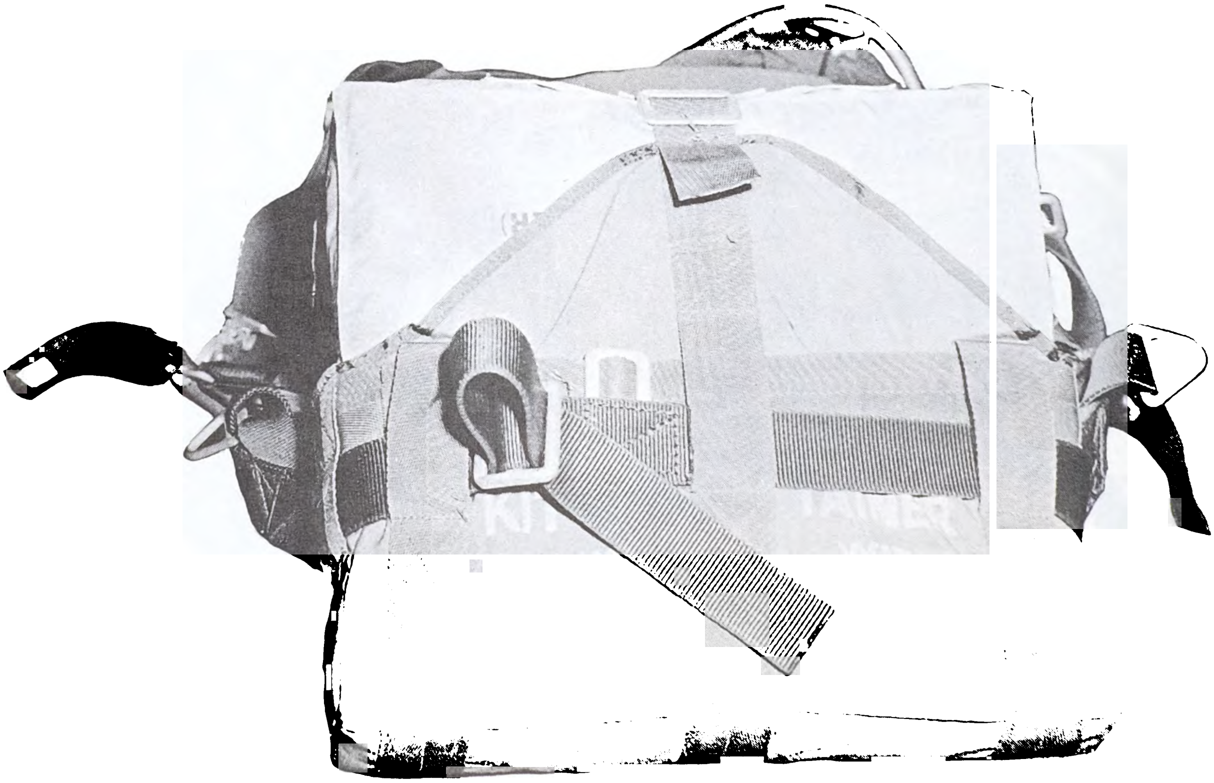


Figure 7-10.—Adapter retaining strap passed through bottom center keeper and opposite retaining strap passed through adapter in preparation for drawing main sling and pararaft kit container together.

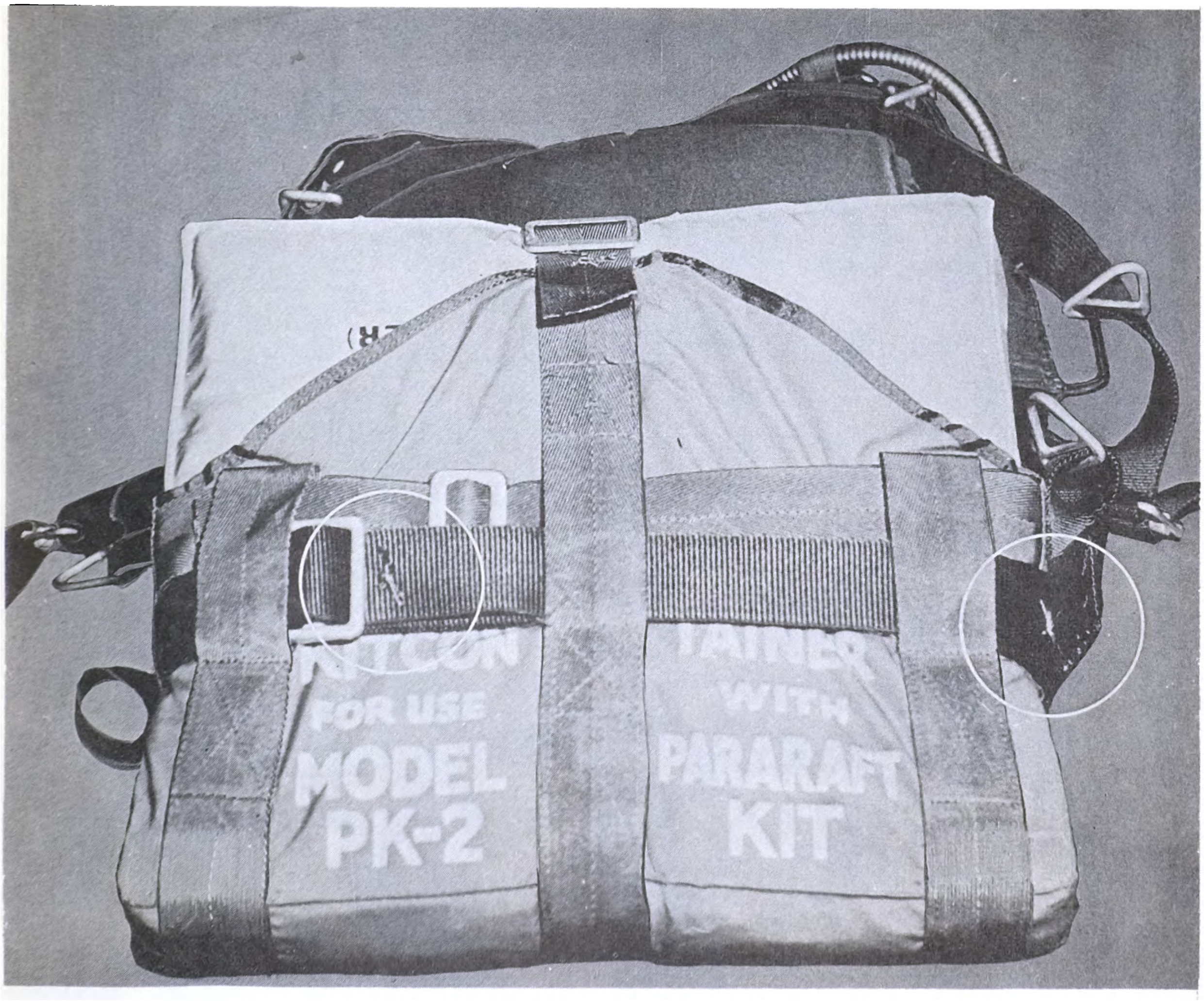


Figure 7-11.—Adjustment made and free end of retaining strap tacked to harness. Second tacking is also made close to adapter and on free side to hold the adjustment.

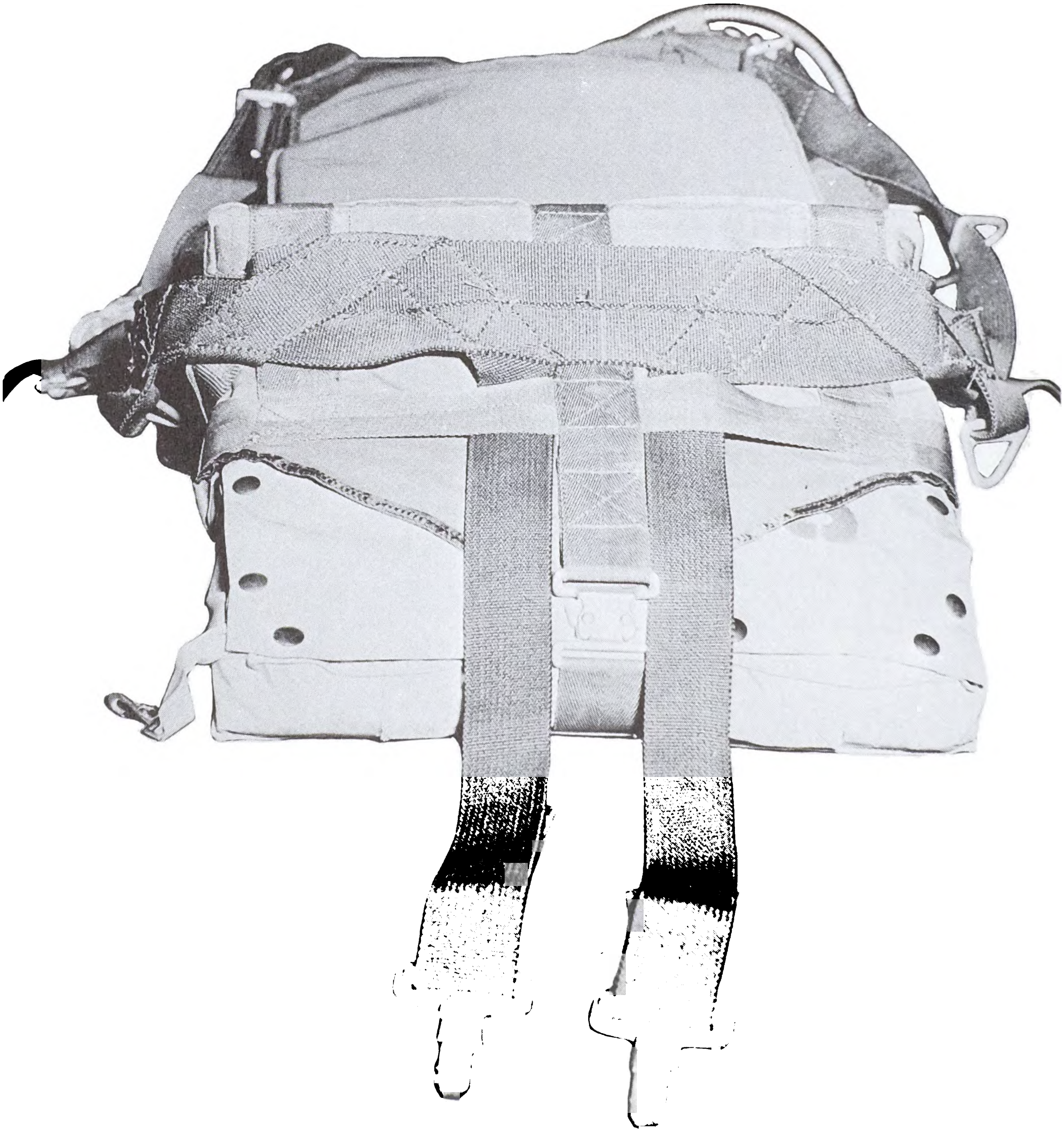


Figure 7-12.—Leg straps passed through keepers on the kit container. This is a very important step as this operation will retain the pararaft kit in its proper position.

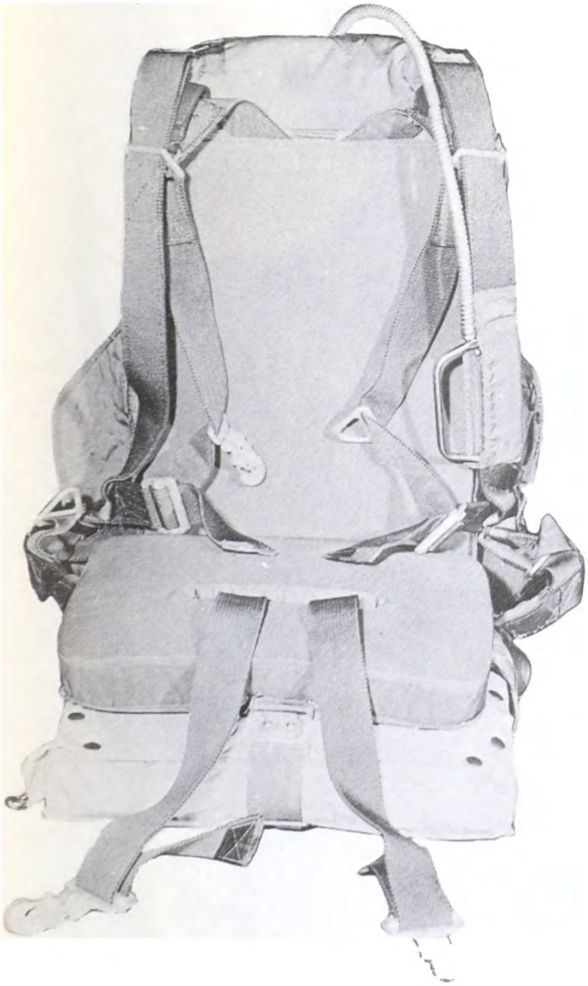


Figure 7-13.—Seat cushion in place and tacked to the pararaft kit container in the same manner as applied to the seat type parachute.

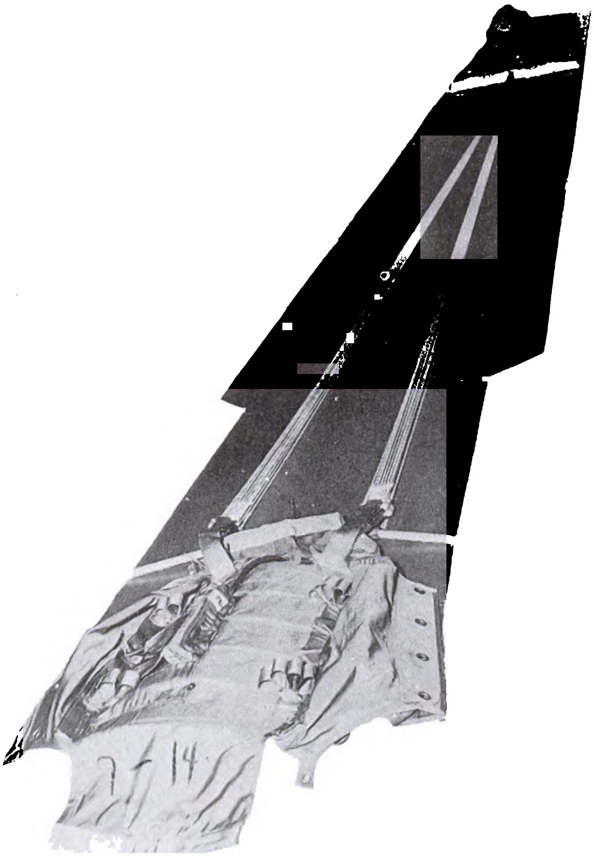


Figure 7-14.—Canopy properly laid out on packing table.

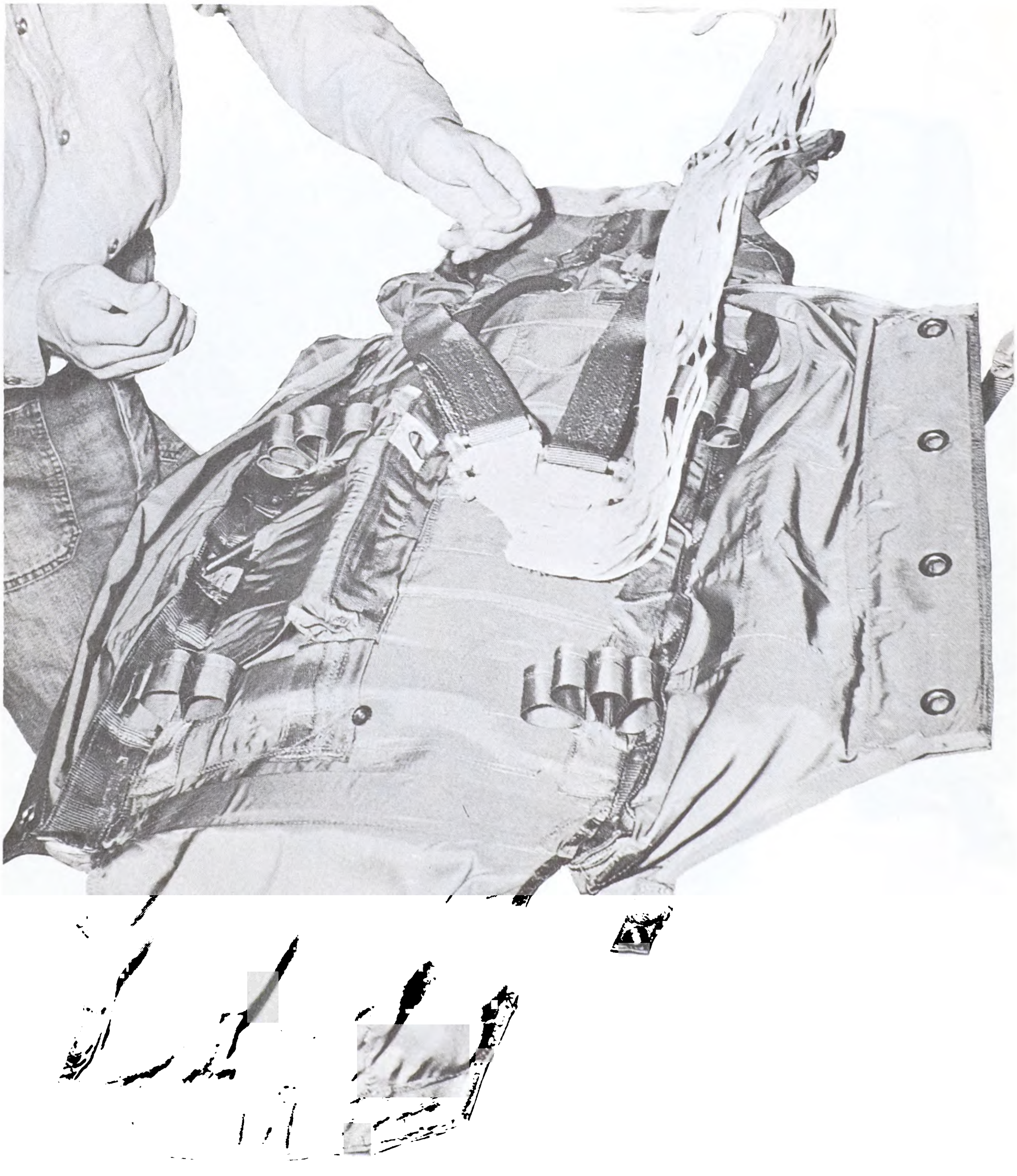


Figure 7-15.—Connector links tacked to container with one turn of 3-cord nylon thread.

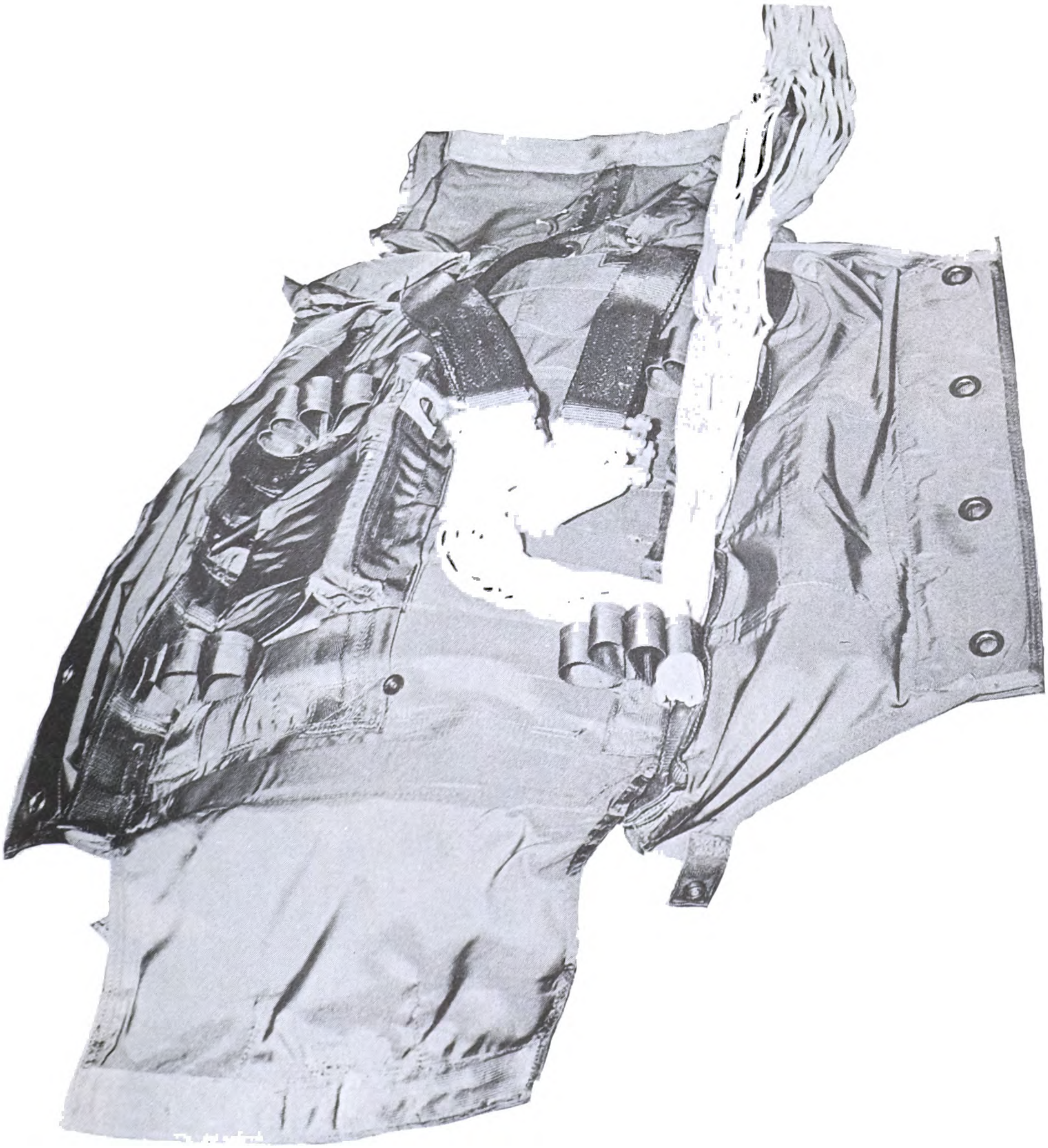


Figure 7-16.—First bight taken in hesitator loop No. 1.

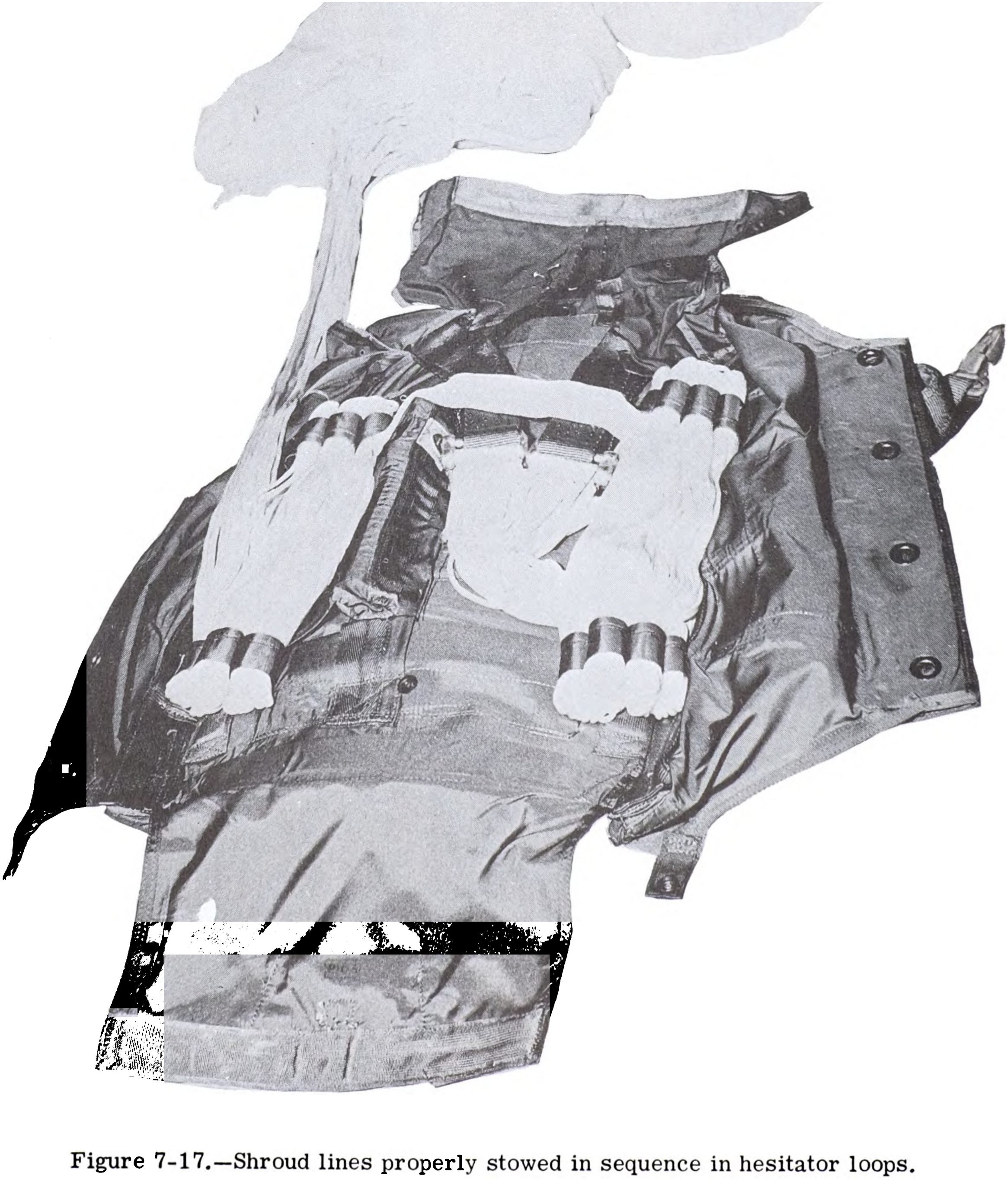


Figure 7-17.—Shroud lines properly stowed in sequence in hesitator loops.

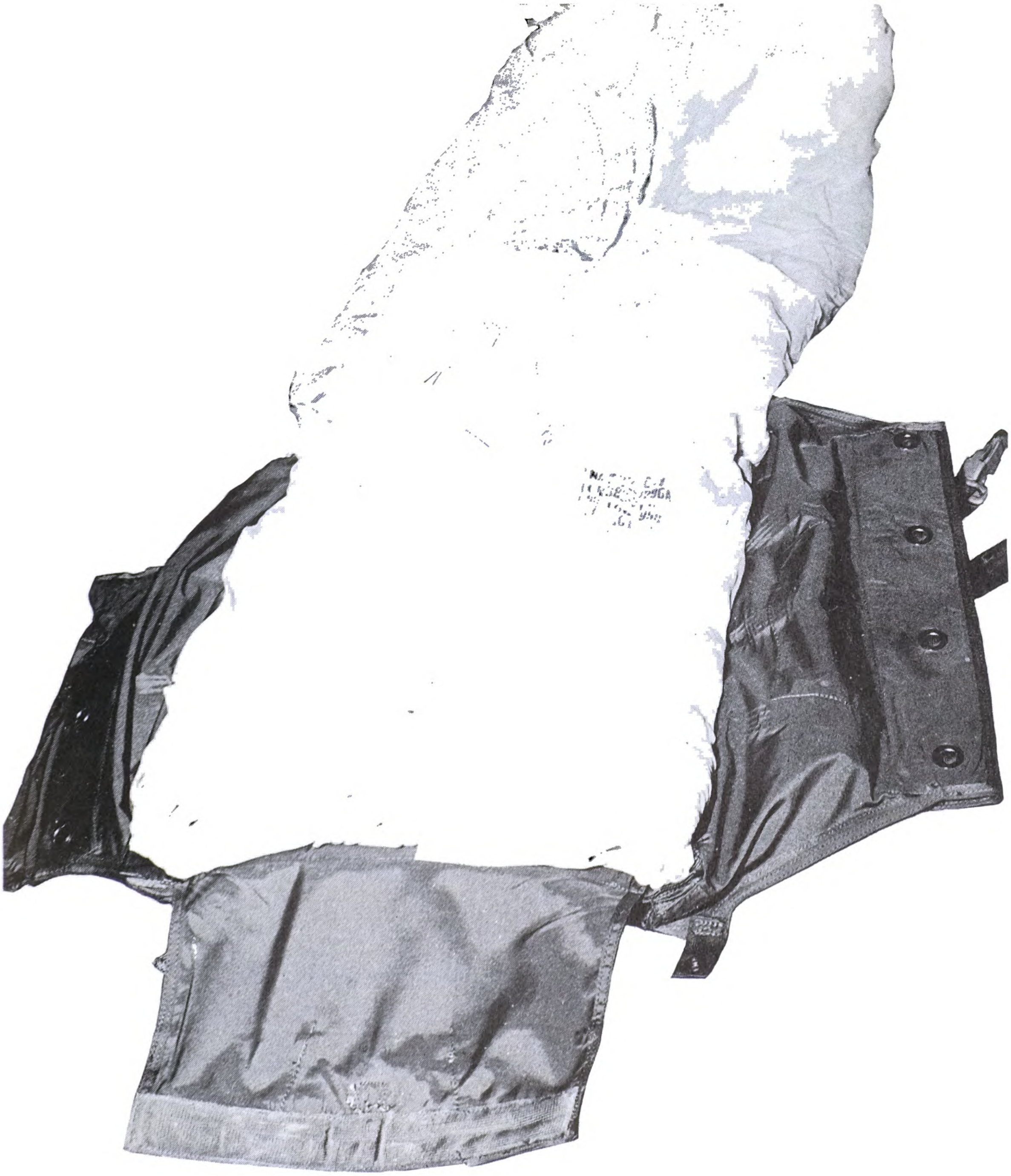


Figure 7-18.—Parachute skirt brought to bottom edge of container.

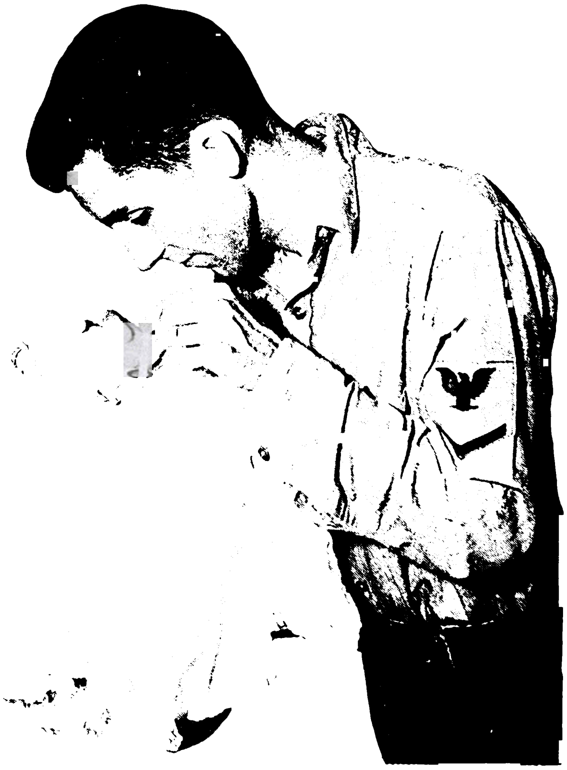


Figure 7-19.—Place guide tube over pilot chute cone.

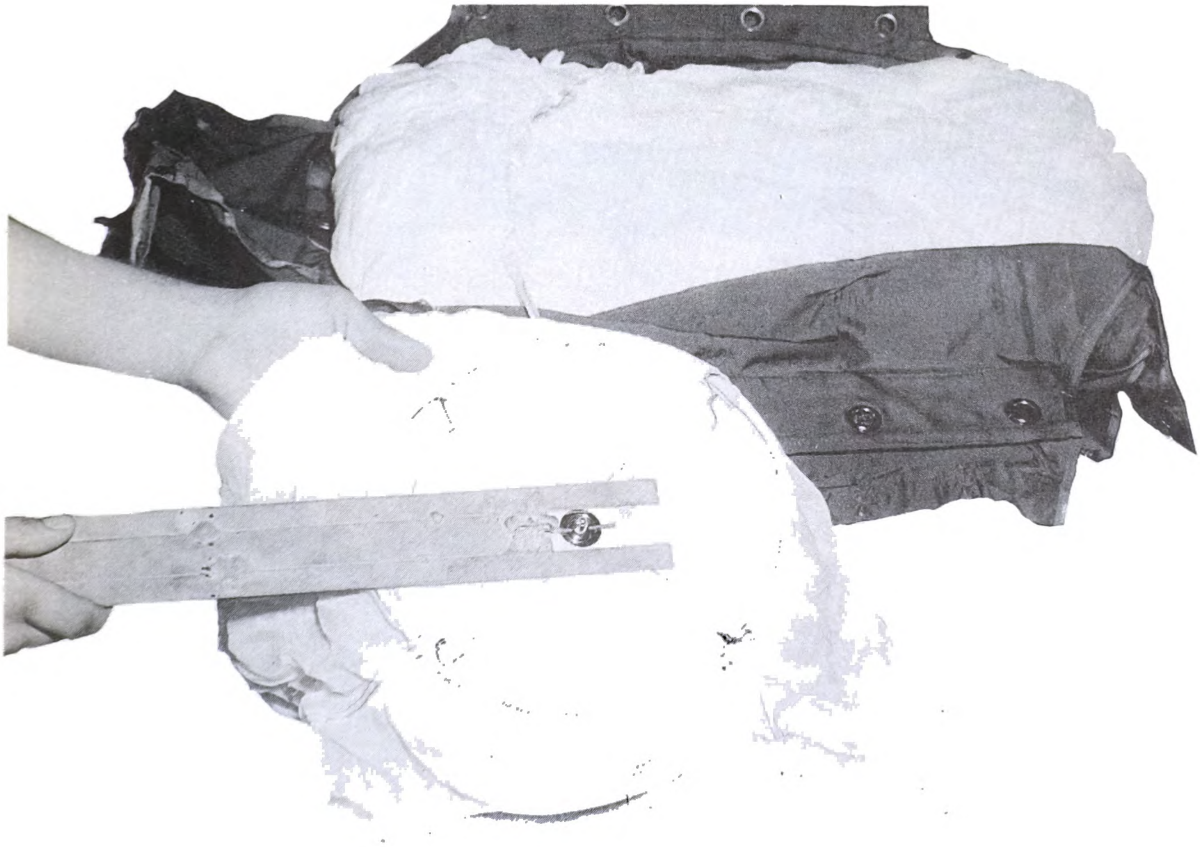


Figure 7-20.—Temporary locking pin placed in lower hole of pilot chute locking cone.

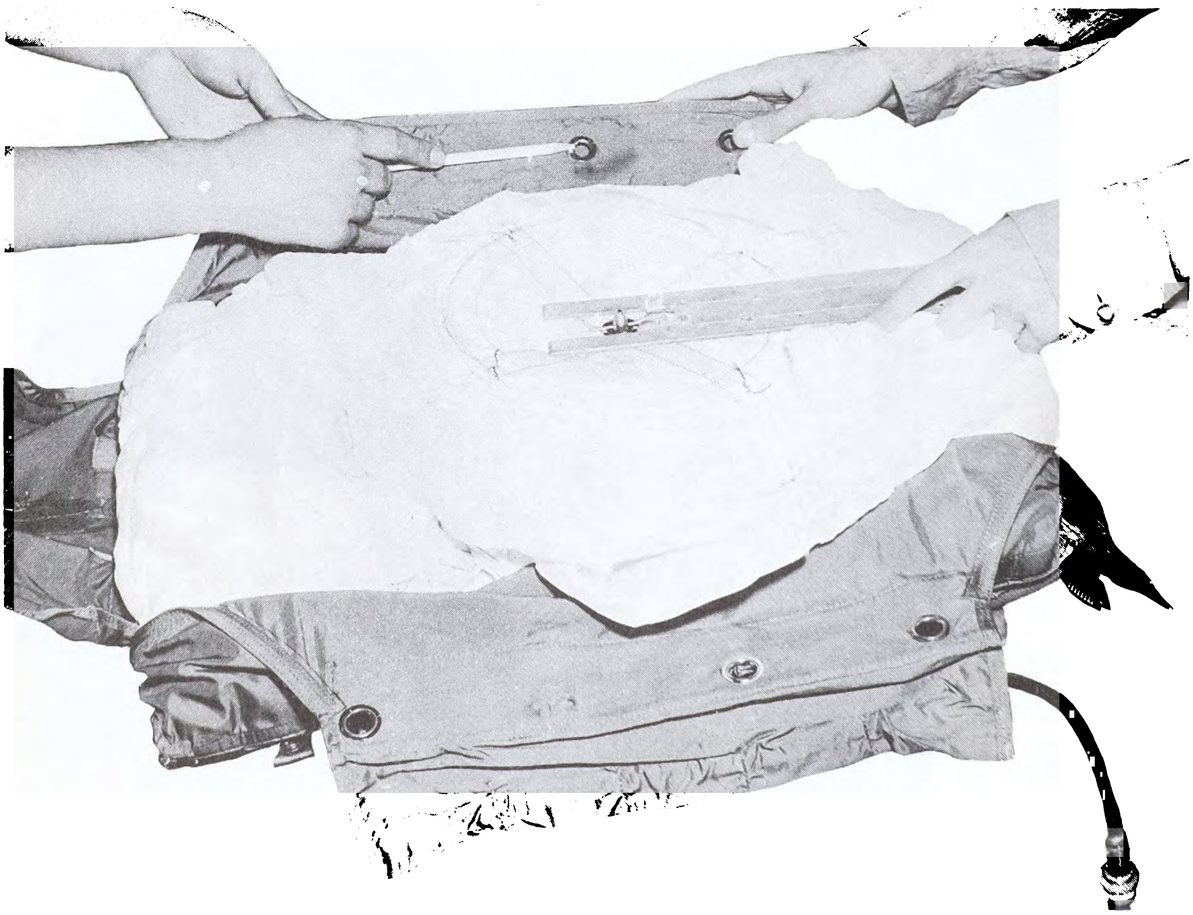


Figure 7-21.—Pilot chute positioned in line with second grommet from bottom of container.

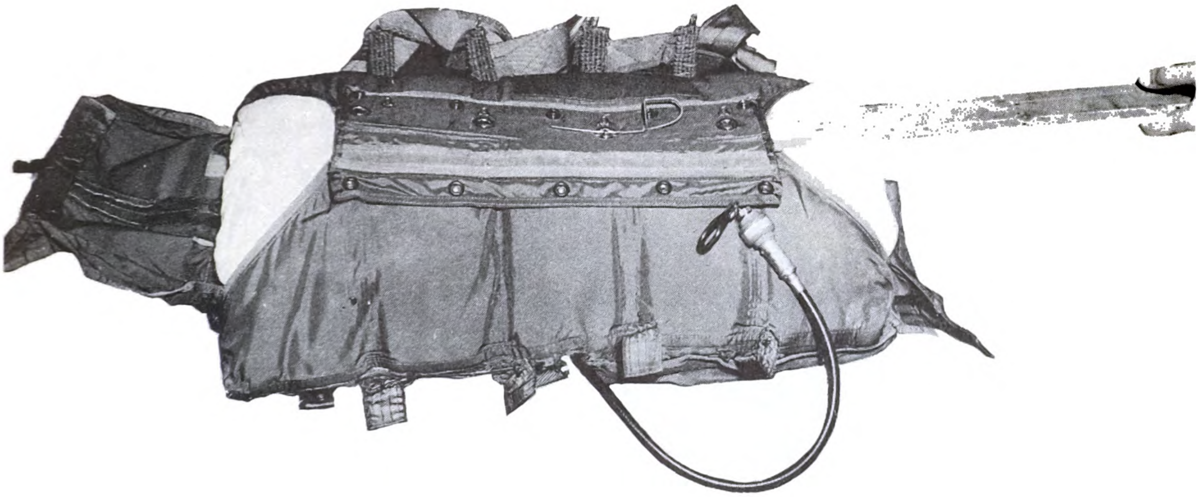


Figure 7-22.—Remove temporary locking pin plate and insert temporary pin.

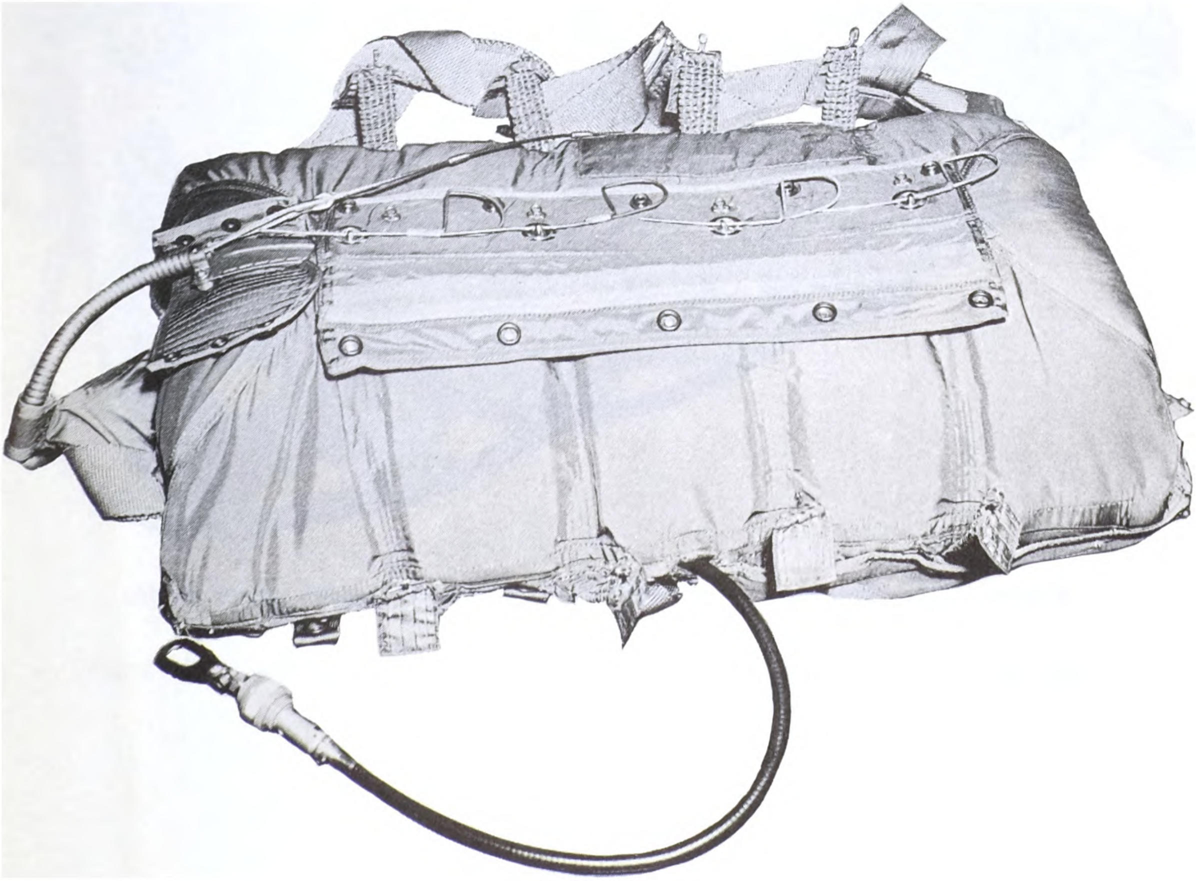


Figure 7-23.—Close end flaps and insert temporary locking pins.

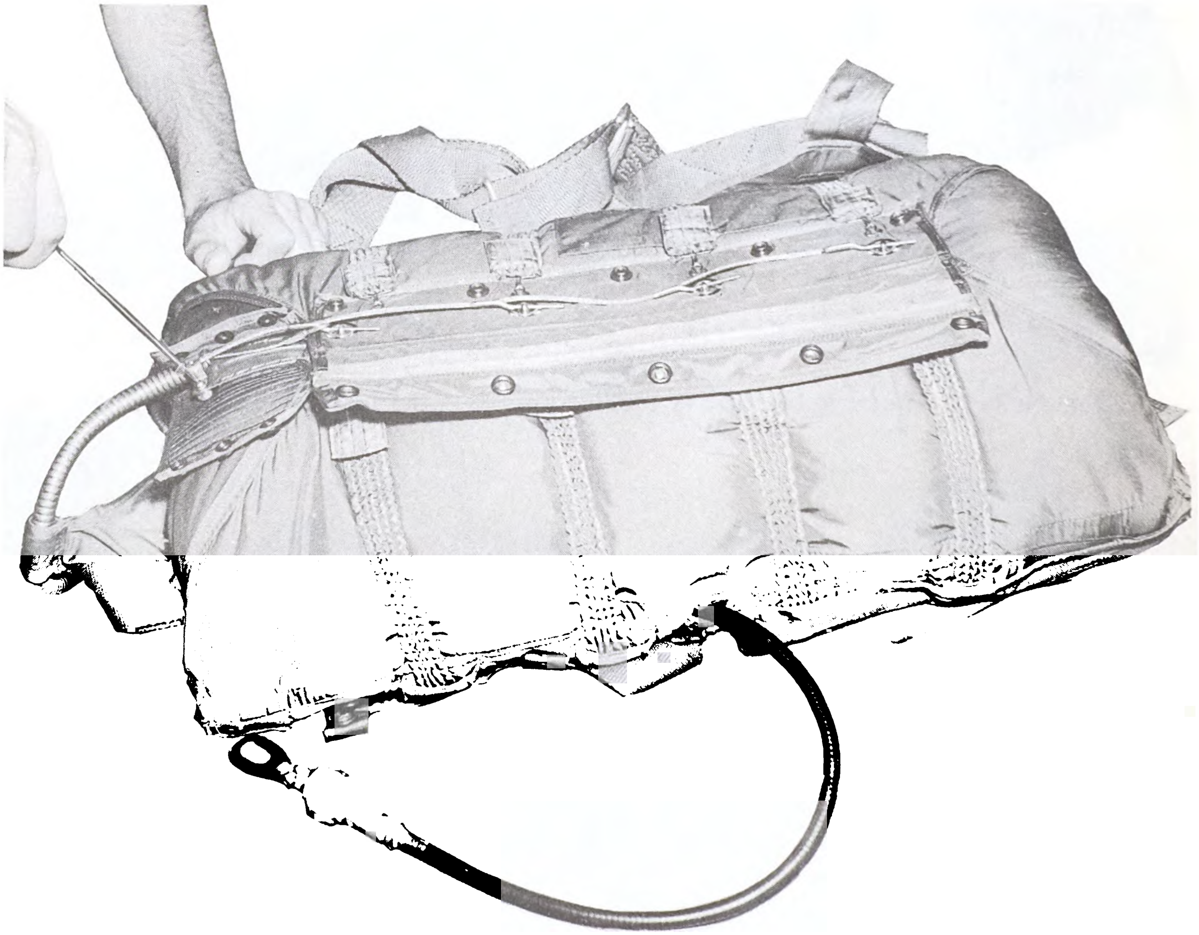


Figure 7-24.—Top ripcord inserted through loop on opener power cable.

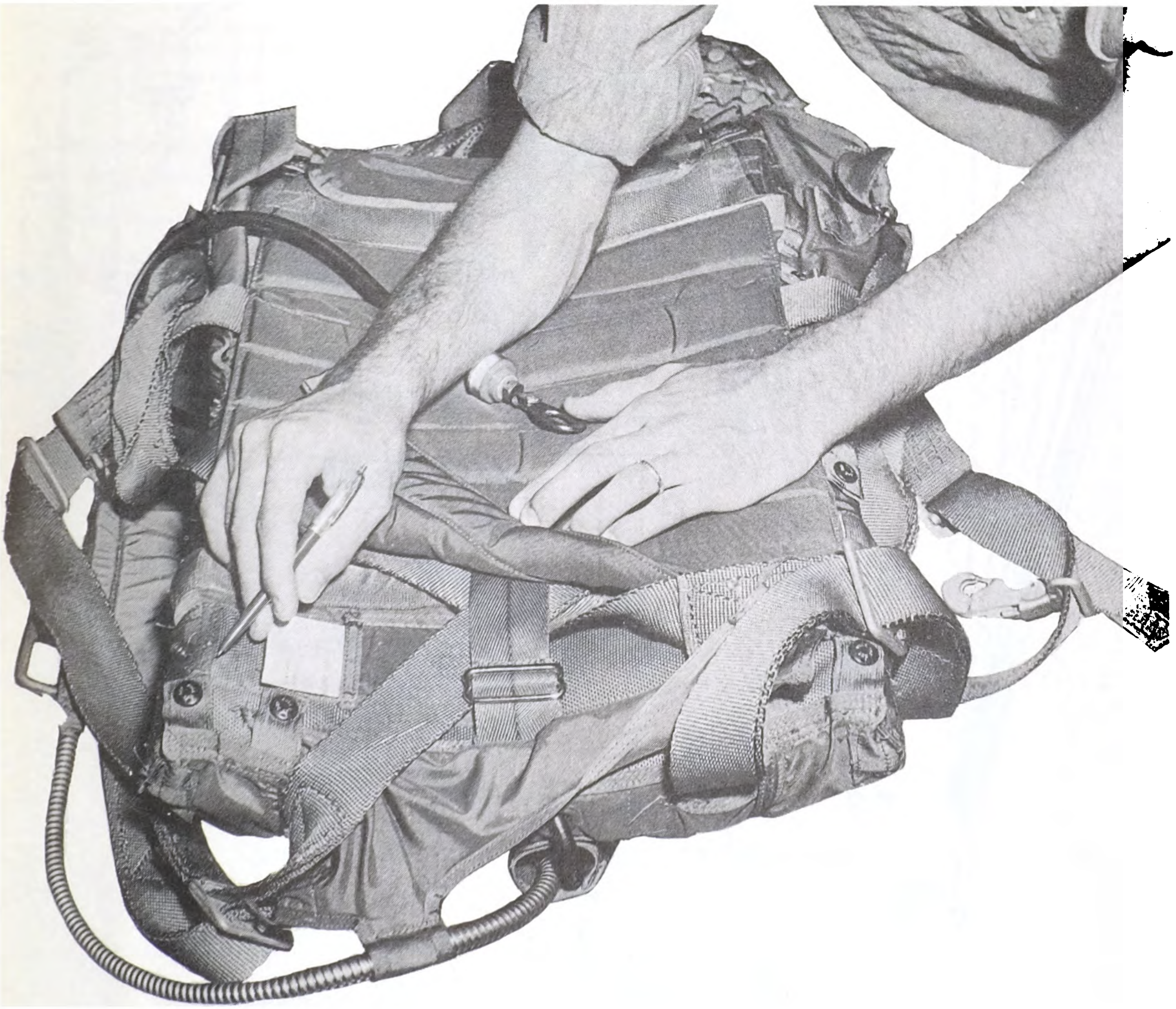


Figure 7-25.—Parachute Record Card being inserted in pocket on parachute.

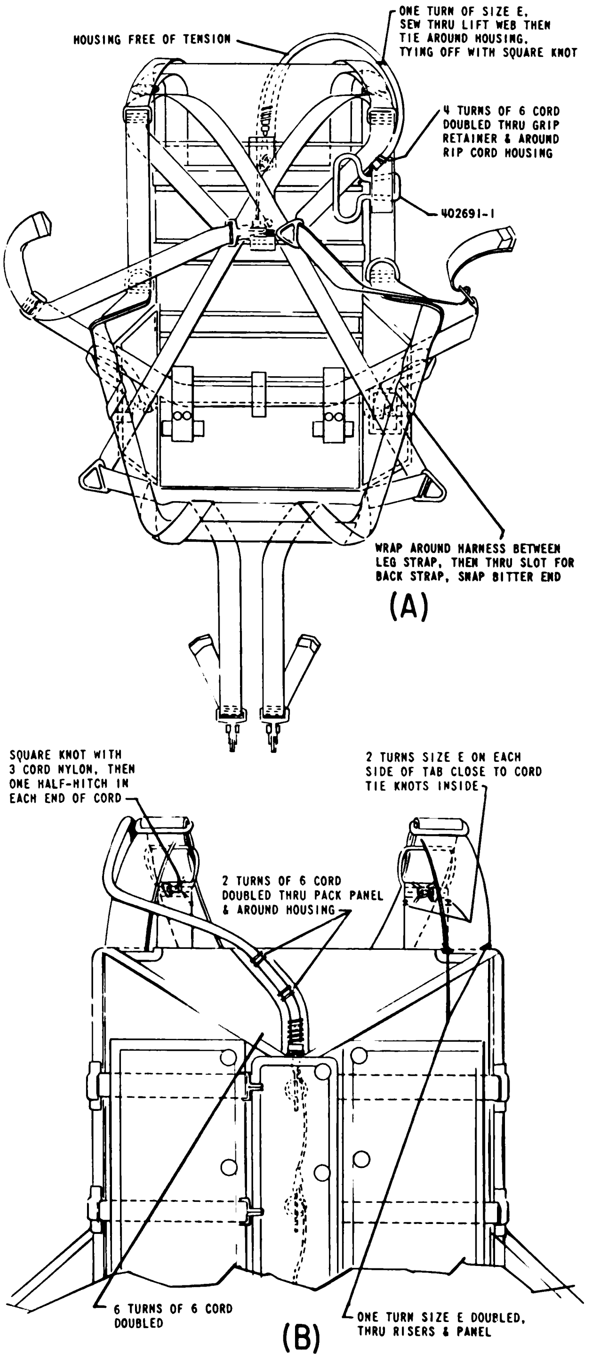

HOUSING FREE OF TENSION
ONE TURN OF SIZE E. SEW THRU LIFT WEB THEN TIE AROUND HOUSING. TYING OFF WITH SQUARE KNOT
4 TURNS OF 6 CORD DOUBLED THRU GRIP RETAINER & AROUND RIP CORD HOUSING
402691-1
WRAP AROUND HARNESS BETWEEN LEG STRAP, THEN THRU SLOT FOR BACK STRAP, SNAP BITTER END
(A)
SQUARE KNOT WITH 3 CORD NYLON, THEN ONE HALF-HITCH IN EACH END OF CORD
2 TURNS SIZE E ON EACH SIDE OF TAB CLOSE TO CORD TIE KNOTS INSIDE
2 TURNS OF 6 CORD DOUBLED THRU PACK PANEL & AROUND HOUSING
6 TURNS OF 6 CORD DOUBLED
ONE TURN SIZE E DOUBLED, THRU RISERS & PANEL
(B)

Figure 7-26.—Rigging diagram for NT-5 back type parachute. (A) Front view; (B) back view.

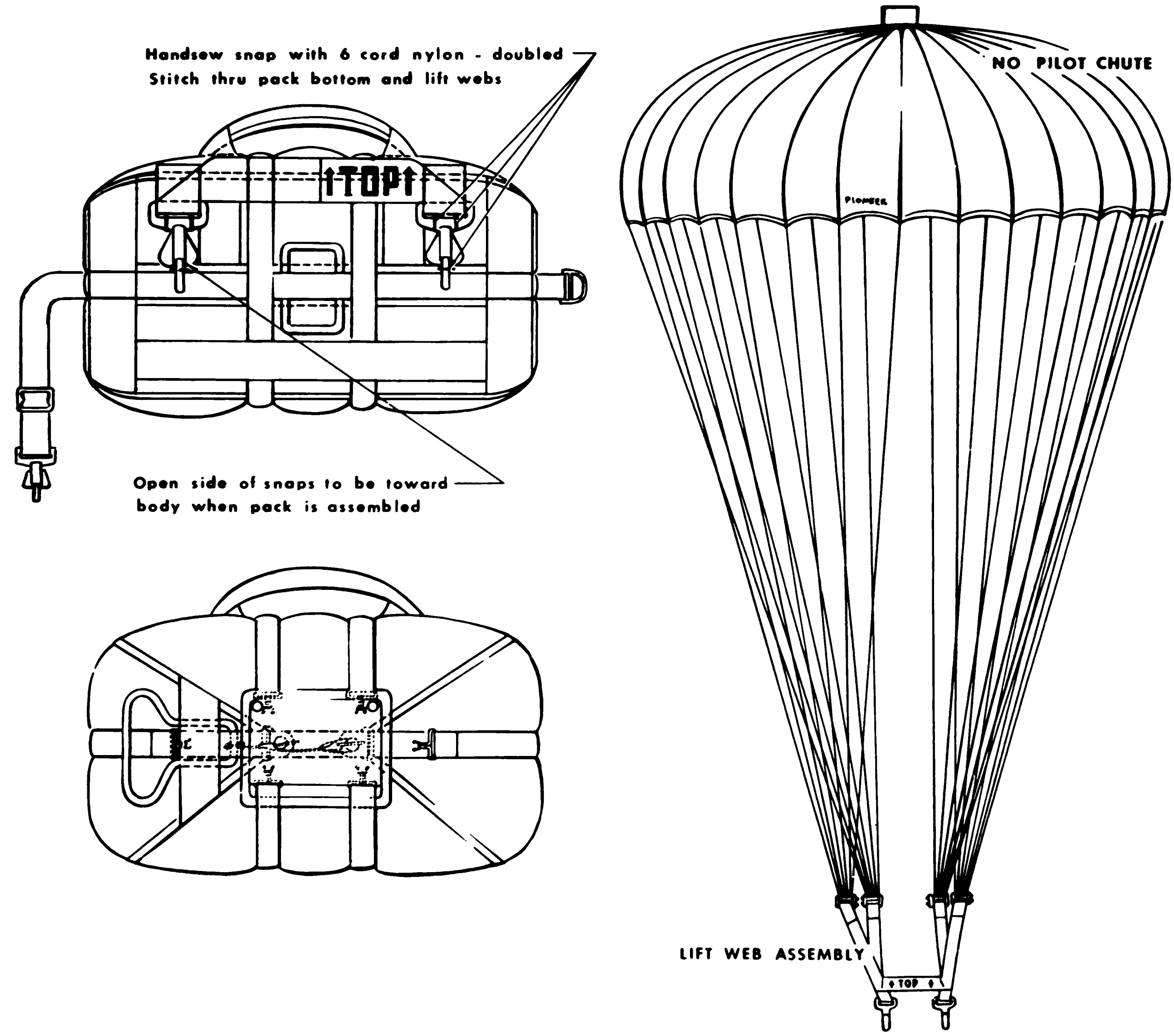

Handsew snap with 6 cord nylon - doubled
Stitch thru pack bottom and lift webs
↑TOP↑
Open side of snaps to be toward
body when pack is assembled
NO PILOT CHUTE
PIONEER
LIFT WEB ASSEMBLY
TOP

Figure 7-27.—Rigging diagram for NT-5 chest type parachute.

QUIZ

1. The NB-3 parachute ripcord has_____pins.
   a. 2
   b. 3
   c. 4
   d. 5

2. The inside Parachute Record Card must be signed
   a. prior to whipping and folding the canopy
   b. after the outside Parachute Record Card
   c. in pen and ink only
   d. prior to stowing the suspension lines

3. The NB-3 ripcord housing is tacked in___ places.
   a. 2
   b. 3
   c. 4
   d. 5

4. The number of harness keepers on the NB-3 container is
   a. 2
   b. 3
   c. 4
   d. 5

5. The first tacking on the NB-3 ripcord housing is made with 6 cord
   a. 6 turns, single
   b. 6 turns, double
   c. 12 turns, single
   d. 12 turns, double

6. To tack the corners of the universal back pad, after snapping to the NB-3 pack, use
   a. 1 turn, A nylon thread, double
   b. 2 turns, A nylon thread, single
   c. 1 turn, 6-cord nylon, double
   d. 2 turns, 6-cord nylon, single

7. When rigging the NB-3, the back pad is tacked in___places.
   a. 2
   b. 3
   c. 4
   d. 7

8. To tack the ripcord hand pull pocket on the NB-3 parachute, use nylon
   a. 3 cord, double
   b. 3 cord, single
   c. 6 cord, double
   d. 6 cord, single

9. The number of hesitator loops used when packing the NB-3 parachute is
   a. 12
   b. 14
   c. 16
   d. 18

10. The integrated harness is used with the Navy parachutes designated as the
    a. NB-5 and NB-7
    b. NB-7 and NB-8
    c. NB-5 and NB-6
    d. NB-6 and NB-8

11. The two pieces of equipment used when inserting the pilot chute on the NB-6 and NB-8 are the
    a. locking pin plate and guide tube
    b. locking cone and guide tube
    c. locking pin and guide tube
    d. ripcord pin and guide tube

12. To tack the connector links in pairs, inside the NB-6 and NB-8 container, use one turn of
    a. 3-cord nylon, double
    b. 3-cord nylon, single
    c. 6-cord nylon, double
    d. 6-cord nylon, single

13. When the suspension lines are properly stowed in the NB-6 and NB-8 they protrude through the hesitator loops approximately
    a. 1/4 inch
    b. 3/8 inch
    c. 1/2 inch
    d. 3/4 inch

14. When laying out the NB-6 and NB-8 parachutes for packing, the man is lying on his
    a. back, head towards the canopy
    b. stomach, head toward the canopy
    c. back, head away from the canopy
    d. stomach, head away from the canopy

15. When stowing the suspension lines in the NB-6 parachute, the number of hesitator loops used is
    a. 12
    b. 14
    c. 16
    d. 18

16. Before stowing the suspension lines in the NB-6 and NB-8 parachute, the links are tacked to the
    a. second stiffener from the bottom
    b. second stiffener from the top
    c. third stiffener from the bottom
    d. third stiffener from the top

17. When inserting the pararaft into the kit container on the back type parachutes, the snap fasteners on the pararaft kit container must face
    a. up
    b. down
    c. to the wearer's right
    d. to the wearer's left

18. When rigging the pararaft to the back type parachutes, the harness leg straps are passed through the
    a. side loops on the kit container
    b. front loops on the kit container
    c. top loops on the kit container
    d. bottom loops on the kit container

19. The NB-6 and NB-8 parachutes use the
    a. torso harness suit
    b. torso harness flight suit
    c. standard Navy parachute harness
    d. NC-3 harness

20. The ripcord pin that is passed through the loop on the automatic parachute actuator power cable is number
    a. 1
    b. 2
    c. 3
    d. 4

CHAPTER 8

PACKING AND RIGGING THE MARTIN-BAKER PARACHUTE

The Martin-Baker parachute is designed to be used with the Martin-Baker ejection system. The complete ejection system consists of an ejection seat, ejection gun, drogue gun, two drogue parachutes, time release mechanism, and personnel parachute and harness assembly.

The system is designed to provide safe escape at all altitudes and speeds, and after ejection, to automatically extract the personnel parachute and lift the occupant from the ejection seat.

Ejection at ground level during takeoff or landing when the airspeed is 100 knots or over is both safe and practicable because of the high ejection velocity of the ejection gun and the rapid extraction of the personnel parachute.

When ejection is made at high altitudes, an automatic parachute actuator (chapter 10) delays the opening of the personnel parachute and separation of the occupant from the seat, so that the occupant may descend quickly through rarefied atmosphere.

Normal ejection is accomplished by pulling a face blind (curtain). A secondary handle is located on the forward part of the seat bucket and is used if normal ejection cannot be effected. Either action causes the seat to be propelled upward by three successively fired cartridges operating in a telescoping ejection gun composed of three cylinders.

After ejection, the two drogue parachutes are deployed to stabilize and decelerate the seat. At the proper time, a time release mechanism will cause the harness assembly to be released from its points of attachment to the seat and will cause the drogue parachutes to be detached from the seat, permitting them to extract and deploy the personnel parachute. The personnel parachute then pulls the occupant in his harness from the seat.

Although personnel of the AME rating are responsible for the removal and installation of the seat and its components, the Parachute Rigger is responsible for packing and rigging both the drogue chutes and the personnel parachute.

Drogue Parachutes

The drogue parachutes consist of one 22-inch controller drogue, one 5-foot stabilizer drogue, and attaching parts. (See fig. 8-1.) The two drogue parachutes are stowed in the drogue parachutes container (headrest) structure at the top of the seat. The controller drogue is packed on top of the stabilizer with a protective cloth sleeve between the two. The packed controller is covered by four cloth flaps which are secured by a pin, attached to the controller drogue withdrawal line.

The face blind is stowed in a separate compartment at the front of the drogue parachutes container. The face blind handle cross tube is retained at each end by a spring-loaded pin which engages in a hole in the side of the container. The face blind straps extend aft through a channel-shaped housing within the container on each side and terminate in lugs which are retained by the link line pins. The face blind firing cable passes aft through the container and emerges between the flaps, together with the alternative firing cable.

REMOVAL AND INSTALLATION

In order to assure safe operation of the seat, it is essential that the drogue parachutes be properly packed, and that the lines are correctly routed.

The drogue parachutes should normally be inspected and repacked at intervals of 60 days, unless required more frequently by unusual circumstances. This work should be done only by personnel qualified in parachute handling.

It is not necessary to remove the drogue parachutes to the parachute loft for repacking. It is recommended that this work be done indoors with a clean surface available on which the parts

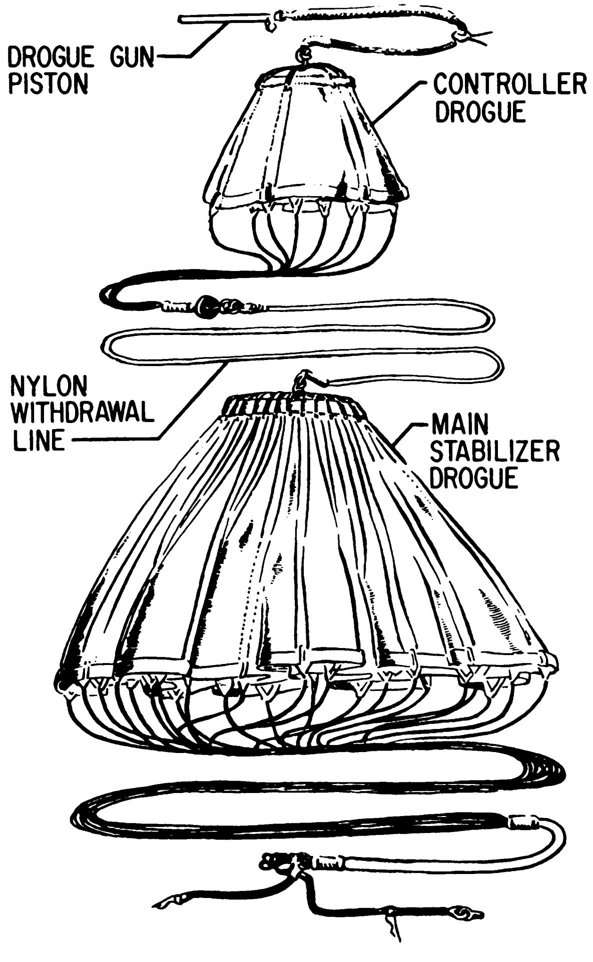


Figure 8-1.—Martin-Baker drogue parachutes.

may be laid, but it may be performed on the aircraft if necessary.

The following safety precautions must be observed:

1. If seat is not installed in the aircraft, check that the ejection gun is not with the seat and that the drogue gun is either unloaded (barrel removed) or safetied (safety pin in hole).
2. If the seat is installed in the aircraft, check that the safety pins are installed in the ejection gun sear and in the drogue gun safety pin hole.

The life of the face blind is 24 months after installation in the aircraft. The expiration date is stamped or stenciled on the face blind. The face blind should be replaced with a new one when the life period has expired. Expiration dates and replacements must be recorded in the aircraft logbook.

Removal of Face Blind

Retaining the safety pin in the ejection gun sear, push the sear forward and remove two firing cable eyes from the hook of the sear. This step is not necessary if the seat is not mounted on the ejection gun.

Remove the safety pin from the face blind and stow in the clip on the seat pan.

Pull on the red handle to extend the face blind and then pull the firing cable forward through the hole in the container.

Pull the link line pins out of the fittings at the sides of the container to free the lugs at the ends of the face blind straps. The face blind may now be removed from the seat. This step is necessary only if it is desired to remove the face blind from the seat.

Removal of Drogue Parachutes

Disconnect controller drogue withdrawal line from the drogue gun piston by removing the nut and bolt. Temporarily, replace the bolt and nut in the small shackle.

Break and remove the safe-tie thread on the flap securing pin.

Pull the flap securing pin out of the flap pocket and out of the wire loop on the flap. The pin will also be pulled out of the shackle safe-tie loop. This loop of nylon line may be reinstalled later if not damaged.

Lift up the scissor and shackle to a vertical position.

Placing the alternative firing cable to one side, fold back the four flaps and pull out the controller drogue by means of its withdrawal line.

Pull out the protective sleeve and pull out the stabilizer drogue by means of its withdrawal line.

Note that the drogue shackle is still held in the scissor and retains the stabilizer drogue shroud lines. It is not necessary to break this connection; but if it is desired to remove the drogue parachutes from the seat, proceed as follows:

1. Unscrew the link line connector, if the personnel parachute is installed.
2. Operate the time release mechanism by pulling the trip rod sear. Keep hands away from descending plungers to avoid injury. After operation, replace the trip rod sear fully home in the time release mechanism.
3. Open the scissor and remove the shackle. The link line will also be removed, as it is attached to the shackle.

Examine the drogue parachutes, shroud lines, withdrawal lines, shackle attachments, etc., for evidences of possible deterioration. Take corrective action if necessary.

Clean the inside of the drogue parachutes container.

Packing Stabilizer Drogue Parachute

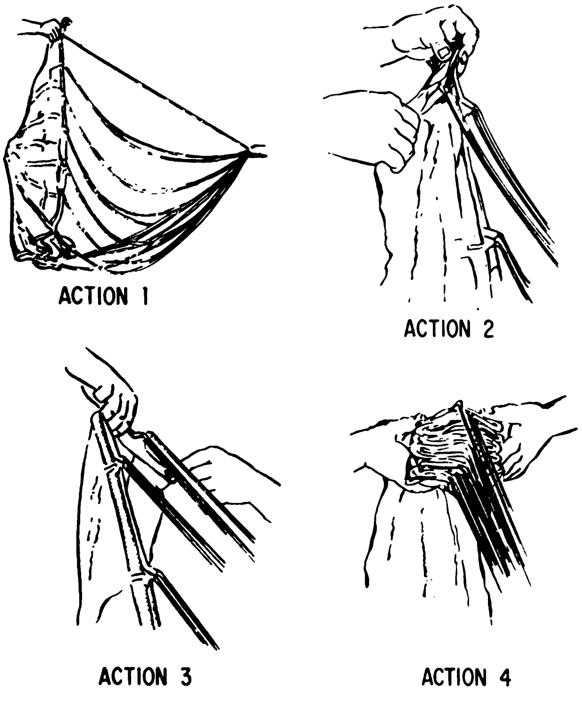
Open the four flaps. Pull up the protective sleeve and roll it down so that it does not obstruct the packing.

If the drogue shackle has been removed from the scissor, proceed as follows:

1. Place the shackle bolt within the jaws and close the scissor. The link line should be forward and the eye of the stabilizer drogue shroud line should be aft.
2. Cock the time release mechanism. The shackle will then be retained in the scissor.

Holding the stabilizer drogue, extend the shroud lines from the shackle and straighten them out, so that they are not twisted or tangled.

Pair off the 24 shroud lines and fold the skirt into 6 double folds. (See fig. 8-2.)



ACTION 1

ACTION 2

ACTION 3

ACTION 4

Figure 8-2.—Pairing the shroud lines.

Holding the folds (a shot bag may be used), stow the shroud lines as follows:

1. Lead the sleeve protected portion from the shackle down the right aft corner of the container.
2. Stow the remainder of the shroud lines in the bottom of the container by looping them from side to side.

Stow the stabilizer drogue on top of the shroud lines. Insert the skirt first and pack the parachute in accordion fashion well down into the container. The apex remains on top. (See fig. 8-3 (A).)

Unroll the protective sleeve and pack it down into the container to cover the stabilizer drogue. At the same time, bring the withdrawal line out at the right aft corner of the container, together with the shroud (shackle) line.

Packing Controller Drogue Parachute

Holding the controller drogue, extend the shroud lines and the stabilizer drogue withdrawal line and straighten them out, so that they are not twisted or tangled.

Pair off the 10 shroud lines and fold the skirt into 3 single folds.

Holding the folds (a shot bag may be used), stow the lines as follows:

1. Folding the withdrawal line into about 7 folds, place it in the front part of the container.
2. Loop the shroud lines over the remainder of the protective sleeve.

Fold the apex of the controller drogue on top of the skirt and stow in the container with the apex toward the left aft corner of the container toward the drogue gun, then pack it down. (See fig. 8-3 (B).)

The controller drogue withdrawal line must emerge from the left aft corner of the container toward the drogue gun. Loop the line behind the parachute so that 3 inches of line are exposed beyond the flap securing pin.

Closing Flaps and Stowing Face Blind

If the face blind has been removed from the seat, proceed as follows:

1. Bring the face blind up to the headrest with the firing cable on top. (See fig. 8-4.)
2. Push the strap lugs back through the housings on each side and locate the lugs in the fittings for the link line pins, being sure the straps are not twisted.
3. Insert the link line pins into fittings at sides of the headrest, making sure they pass through the lugs of the face blind straps and the lugs of the parachute restraint straps, if installed.

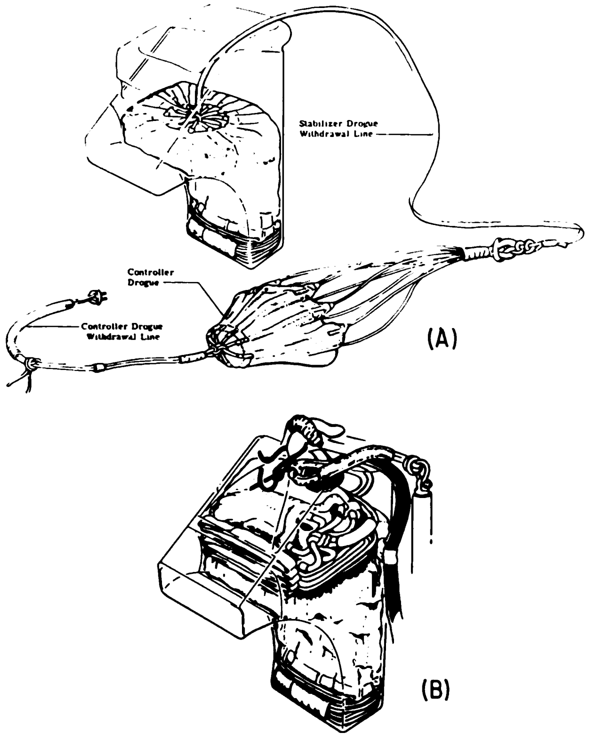

Stabilizer Drogue Withdrawal Line
Controller Drogue
Controller Drogue Withdrawal Line
(A)
(B)

Figure 8-3.—(A) Stabilizer drogue stowed.
(B) Controller drogue stowed.

4. Make up the link line connector, if removed, and personnel parachute is installed.

Pass the face blind firing cable through the hole in the center of the container and lead aft. During this operation, push the packed parachute down with the finger to assure there is no entanglement.

Fold the undersides of the face blind to the width of the container mouth.

Fold under the stitched aft end of the face blind and insert it into the container.

Close the right, left, rear, and front flaps—in that order. Be sure that the wire loop on the right flap extends up through the grommets on the other three flaps. During this process make certain that the two firing cables pass under the front flap and over the rear flap.

Fold the scissor and shackle forward and down on top of the flaps.

Insert the points of the flap securing pin (on withdrawal line) through the wire loop of the flaps, then through the shackle safe-tie loop, and finally into the pocket on the front flap.

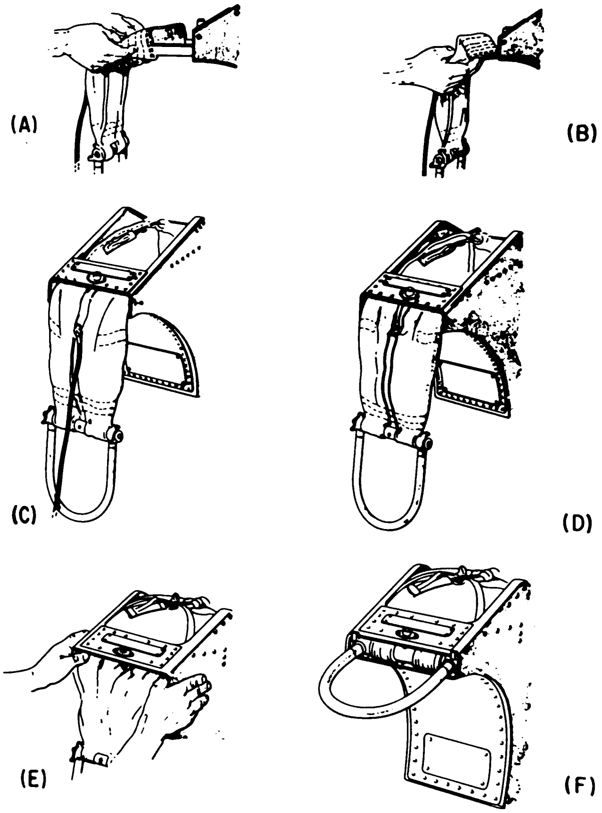


Figure 8-4.—Stowing face blind.

NOTE: If it should be necessary to replace the shackle safe-tie, use nylon line Spec. MIL-C-5040 Type II, 375-pound test, tie the loop with a square knot, and secure each free end to the standing part with three half hitches on size B thread. The loop must pass under the flap securing pin (not through it) between the wire loop and the pocket. The scissor and shackle must be free to lift up when the pin is pulled out by the withdrawal line.

Safe-tie the flap securing pin with a single loop of size B thread, through the eye of the pin and through the loop on the flap pocket; then tie with a square knot.

Stow the remainder of the face blind into the container and, using the thumbs, pack firmly into the sides.

Push the cross tube of the handle into the container, first one side and then the other, retracting the pins in turn. Make sure that the pins extend into the fittings on each side.

Install the face blind firing handle safety pin.

Final Operation

Retaining the safety pin in the ejection gun sear, press the sear forward and engage the eyes of the two firing cables in the hook of the sear. This step must be accomplished later, if the ejection gun is not with the seat. Be sure that cables pass under the withdrawal line, the link line, and scissor.

NOTE: When installing the eyes of the firing cables in the hook of the ejection gun sear, the face blind cable must be installed first, and the alternative firing cable must be installed last to lie on top. The face blind cable is the larger in diameter of the two cables.

Connect the controller drogue withdrawal line to the drogue gun piston with the bolt and nut of the small shackle.

WARNING: It is essential for safe operation of the seat that the withdrawal line be routed over the link line and not under it, so that the withdrawal line is free to extract the controller drogue without entanglement. (See fig. 8-5.)

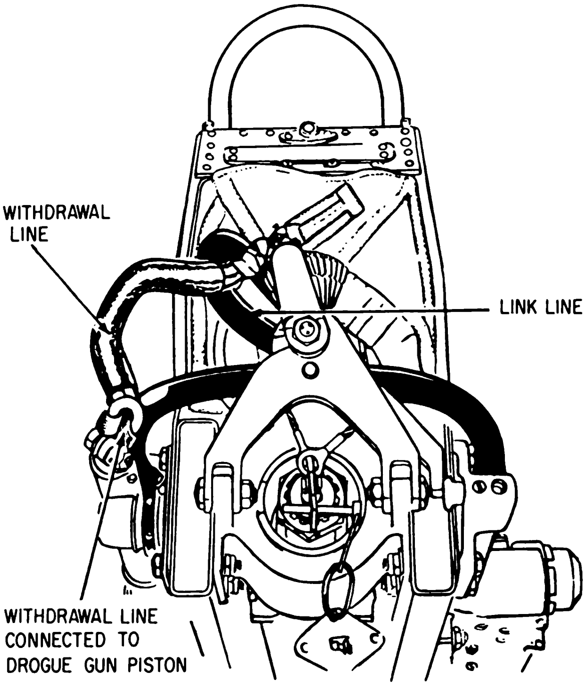


Figure 8-5.—Correct route of drogue withdrawal line.

Personnel Parachute

A standard, Irvin 24-foot, personnel parachute is used with the Martin-Baker ejection seat. The canopy is enclosed in a horseshoe-shaped pack, especially designed for use with this seat. The parachute and harness assembly form an integrated unit.

This section describes the procedure for packing the personnel parachute into the horseshoe pack. The parachute and harness assembly will normally remain installed on the Martin-Baker seat in the aircraft, except when removal for servicing is required. Before beginning the packing, check that the case zippers are open, that elastics are released, and that loose threads are removed. Any parachute in service is required to be repacked every 60 days as specified by applicable directives.

PACKING AND RIGGING

Laying Out Parachute and Harness

As the terms "right" and "left" must be used in the following description, they will be defined here. When parachute is on the table, "left" will be on the operator's left as he faces the head of the table where the apex is secured. NOTE: This convention will be changed when the parachute is removed from the table and placed on the packing stand.

Lay out the parachute on the table with No. 13 panel on top. Extend the shroud lines and separate them into two groups. NOTE: The panel marked No. 1, which bears the label, is the bottom center panel. The panel marked No. 13 is the top center panel. Attach apex to the hook at the head of the table by means of the loop in the pilot chute bridle.

Lay out the parachute case and harness on the table with the locking cones uppermost and the ripcord cable assembly on the right side. Straighten the lift webs and place them on top of the pack. Check that no parts of the harness are twisted. (See fig. 8-6.)

Locate shroud lines No. 13 (left, top) and No. 12 (right, top). Follow these lines down to the connector links; these lines must be on the inside of the upper links. Place the links on the tension bar. (See fig. 8-7.)

Grasp the left and right paired groups of lines and follow them up the skirt of the parachute to assure there are no twists. If there are any twists, pull the case and harness through the

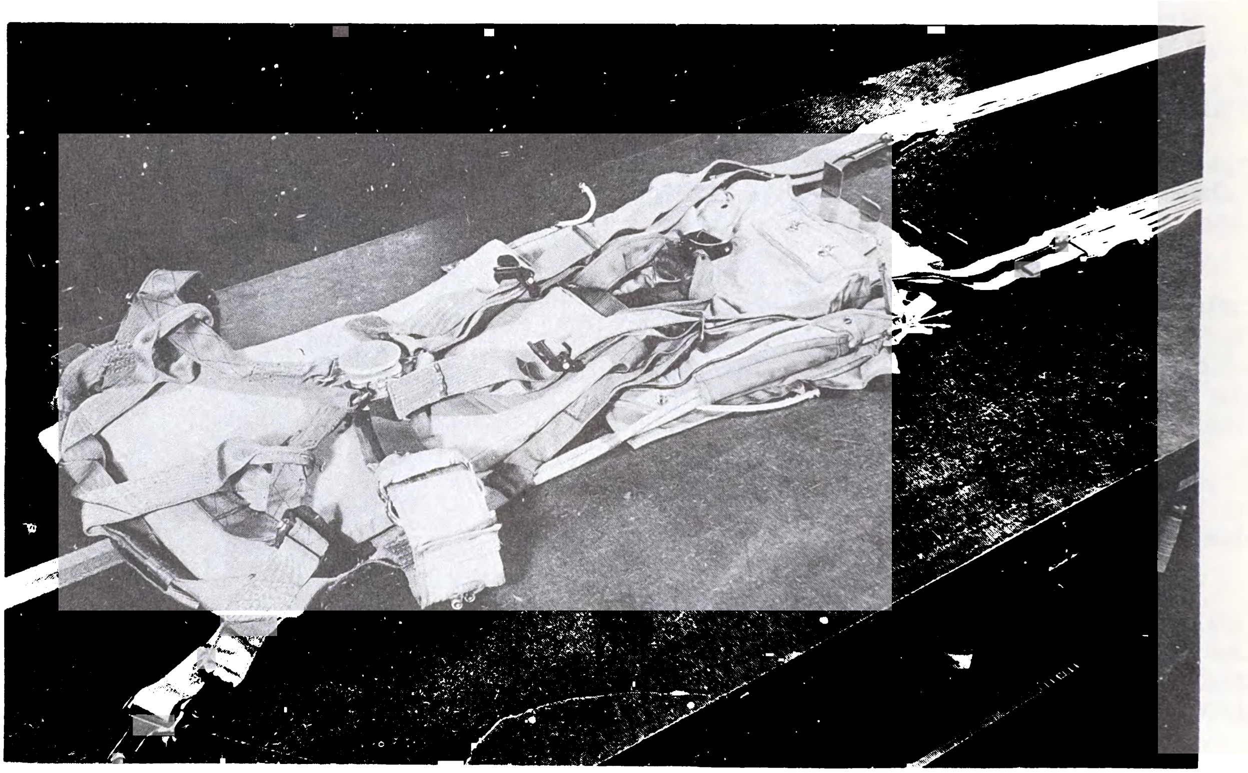


Figure 8-6.—Layout of parachute harness.

lines until straight. Pull the tension bar strap tight. Check that the lines at apex are even and that the vent is equalized. (See fig. 8-8.)

Flaking Canopy

The canopy for the Martin-Baker is flaked in accordance with the authorized procedure given for the standard type parachute in chapter 5.

Folding Canopy

At the skirt, fold each group of twelve panels in a double fold, dividing it into three parts. (See fig. 8-9.) Place a shot bag near the skirt.

Extend this fold on each side, keeping the edges parallel. The folds will run out about four feet from the apex. Place another shot bag across the canopy to hold the upper part of the folds. Remove the tension bar. (See fig. 8-10.)

Securing Lift Webs

Pull parachute slightly toward the skirt, and place the lift webs on the case so that the double stitching for the connectors ends about 2 inches above the edge of the lift web flaps. (See fig. 8-11.)

Hold one lift web against the case cover. Fold the lift web down through its slot and against the inside of the cover, and turn inside out. The fold should begin just before the double stitching on the inside. Holding the double stitched lift web to the case, sew the connector links (2) to the case with one loop of No. 3 cord at each end, as shown in figure 8-12. Tie the loops on the outside with a square knot.

Repeat on the other side of the case. There are four sewn loops altogether. Check that the lift webs and shroud lines are not twisted, and that the ripcord casing run is clear. Pull the parachute case toward and near to the skirt by pulling on the shroud lines. While doing this, loop the shroud lines neatly on either side of the parachute.

Stowing Shroud Lines

On one side stow the shroud lines in retainer loops No. 1 and No. 2, as shown in figure 8-13,

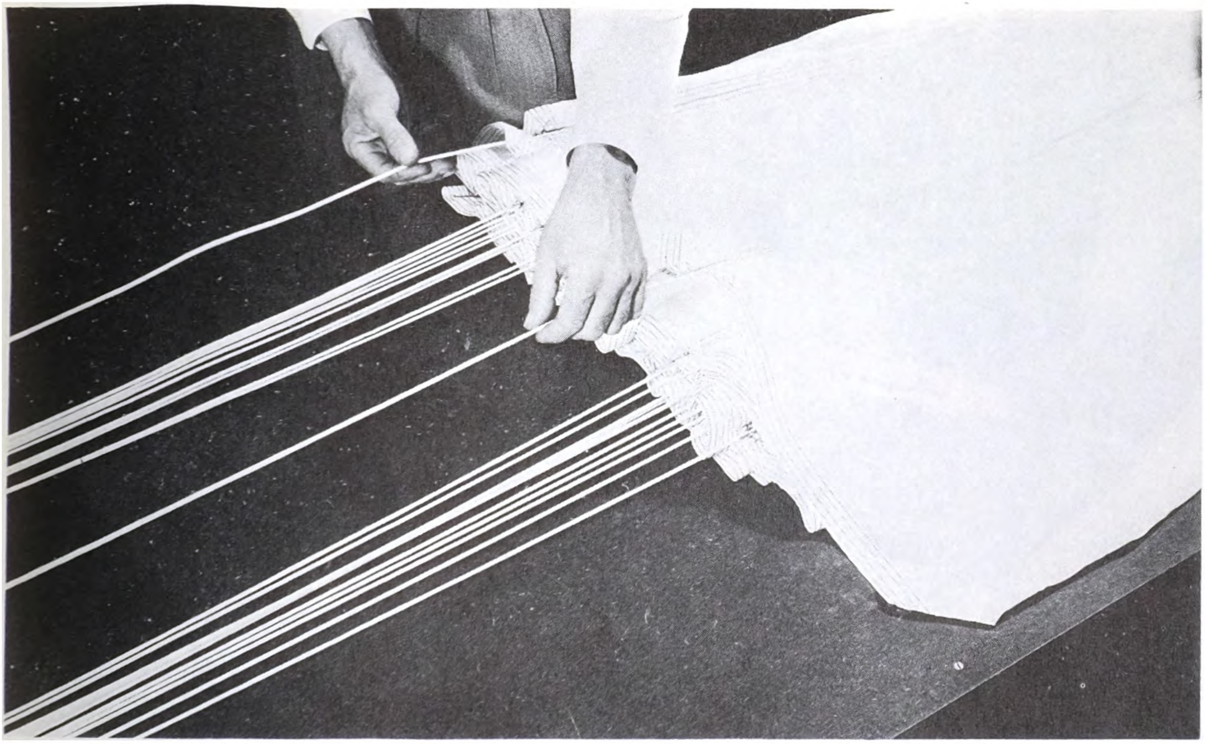


Figure 8-7.—Locating shroud lines.

using the hook. Two hooks may be used to advantage; if the hook is left in the No. 1 loop, while stowing No. 2, the former will remain in place.

Continue stowing the lines in hesitator loops Nos. 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13 as illustrated in figure 8-14.

Repeat steps in figure 8-14, on the other side of the pack, stowing approximately the same length of line.

Bring the two groups of lines together at the arch of the horeshoe. If the lengths to the canopy are unequal, place the junction off center toward the shorter side, as shown in figure 8-15.

Stow all the lines together in hesitator loops Nos. 14, 15, 16, 17, 18, and 19, as illustrated in figure 8-16.

On one side, close the protective flap over the hesitator loops Nos. 1 and 2, pass a length of size 3 cord through the loop on the flap and through the corresponding loop on the pack and tie with a square knot. (See fig. 8-17.) On the same side, close the protective flap over the hesitator loops No. 3 through No. 13 and tie in a similar manner.

Repeat steps shown in figure 8-17.

On one side above the lift web slot, bring together two grommets, one in the side flap and one in the front cover. Pass a single loop of No. 3 cord through both grommets and tie with a square knot. Repeat on other side of the case. (See fig. 8-18.)

Stowing Lower Canopy

Remove the line holder. Remove the hook at the head of the table from the apex of the parachute. Remove the lower shot bag.

Bring the parachute over the case with the skirt touching the arch of the horseshoe. (See fig. 8-19.) Lay open the cover on one side.

Grasp all panels except Nos. 1 and 13 near the center, retaining the double fold with the other hand, and pull this half of the skirt down to about 4 inches from the bottom of the case leg. Panels Nos. 1 and 13 will taper down from the arch of the horseshoe. (See fig. 8-20.)

At the side, grasp the top part of the double fold and pull the skirt down to the bottom of the case leg to finish in a taper (fig. 8-21).

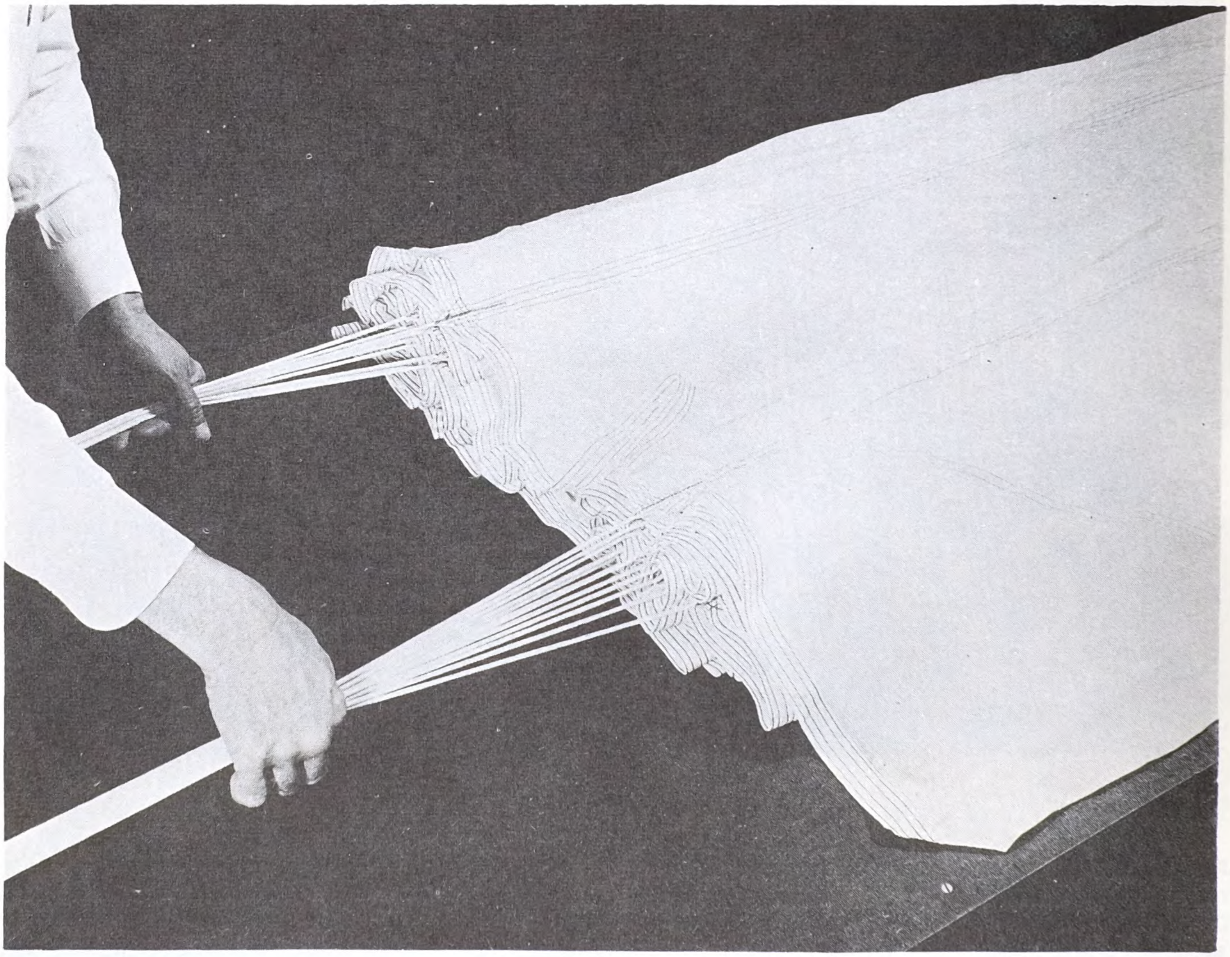


Figure 8-8.—Grasping shroud lines.

Close the zipper at the bottom, tucking the parachute in carefully to insure it is not caught in the zipper. Close the zipper about 6 inches up the side, pulling up the zipper flap between the parachute and the zipper (fig. 8-22).

Repeat this same procedure for the other side of the case.

Stowing Accordion Folds

Remove the shot bag from the parachute. Work on the left side of the table.

Working above the case, bring the edges of the canopy (all panels) together in the hand, retaining the double folds. Select a point that will bring the first fold to the side of the case. (see fig. 8-23.)

Make the first accordion fold even with the right side of the pack, keeping the canopy on the edge. In the same manner, make a similar fold at the right, keeping folds to full width of the case.

Retaining the folds already made against the case, repeat this operation until four folds are made on the right, as illustrated in figure 8-24. The apex should then lie near the left side, and the shroud lines across the vent should be brought to the right.

Lead the parachute withdrawal line off to the right and the pilot parachute bridle off to the left.

Stowing Upper Canopy

Tuck the upper part of the canopy evenly into the case, as shown in figure 8-25. First bring the inner back flap over the parachute, next the front flap, and then the back flap.

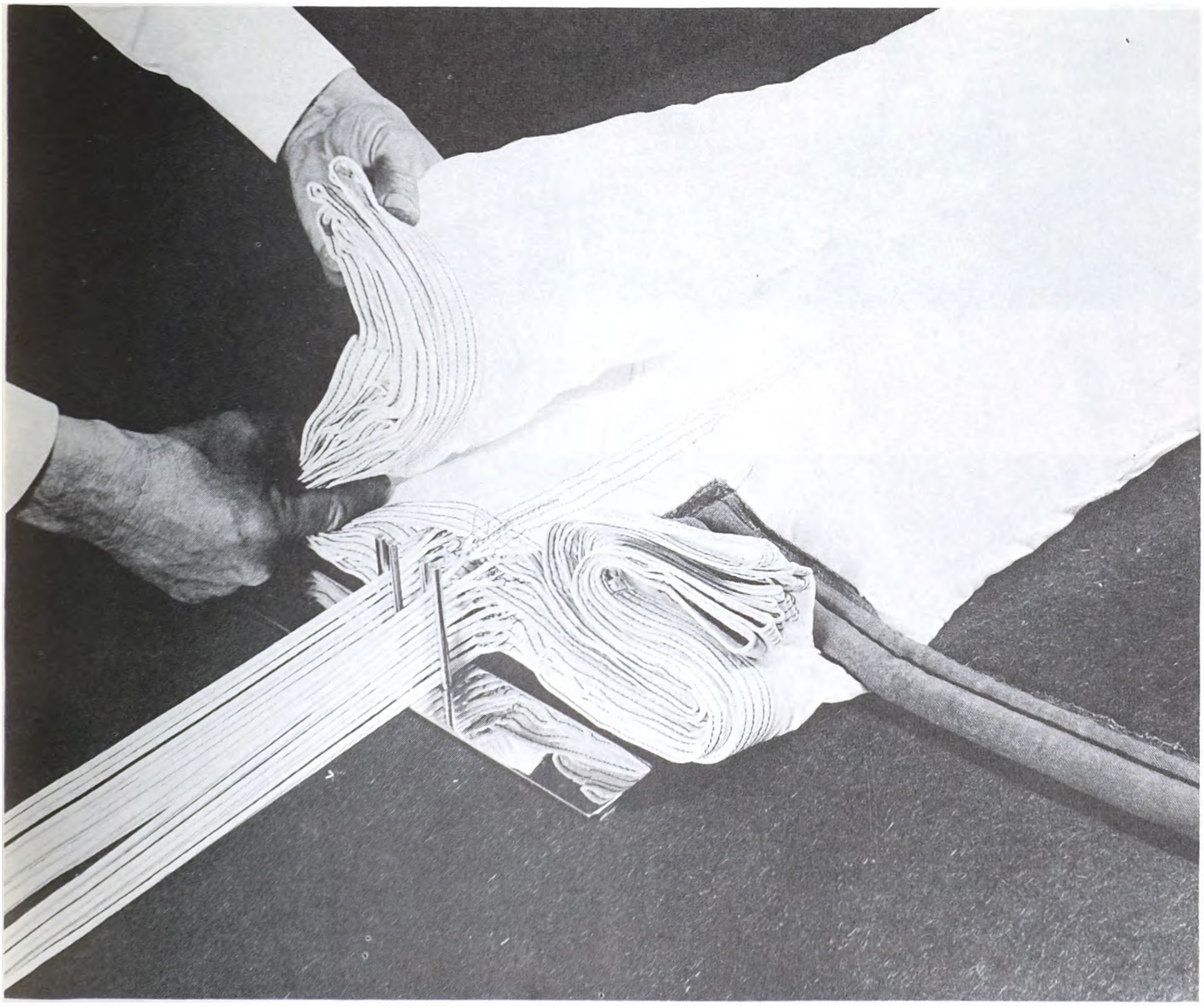


Figure 8-9.—Folding each group of panels.

Place the two back flap grommets over the locking cones on the front flap and secure with temporary pins (fig. 8-26).

On each side tuck in the lift web lower and side flaps downward and aft, respectively, using packing fid inserted into the pocket of the flap. Reaching through the open portion of the zipper, tuck the lower accordion folds down into the hollow appearing in each leg.

Fully close the zippers on each leg, carefully pulling up the zipper flap and slide in successive steps (fig. 8-27).

Closing Flaps

Place the case on the holding stand. Refer to figure 8-28 for locally manufactured holding stand.

NOTE: At this point the terms ''right'' and ''left'' must be redefined. Throughout the remainder of the description, ''left'' will be on the operator's left as he stands behind the parachute pack mounted on the holding stand. Remove the temporary pins, open the flaps, and tuck the canopy down into the case.

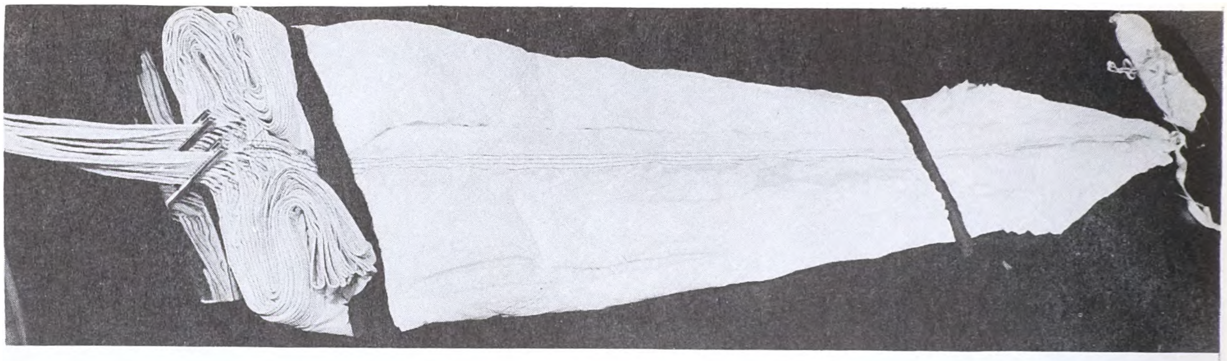


Figure 8-10.—Extending the folds.

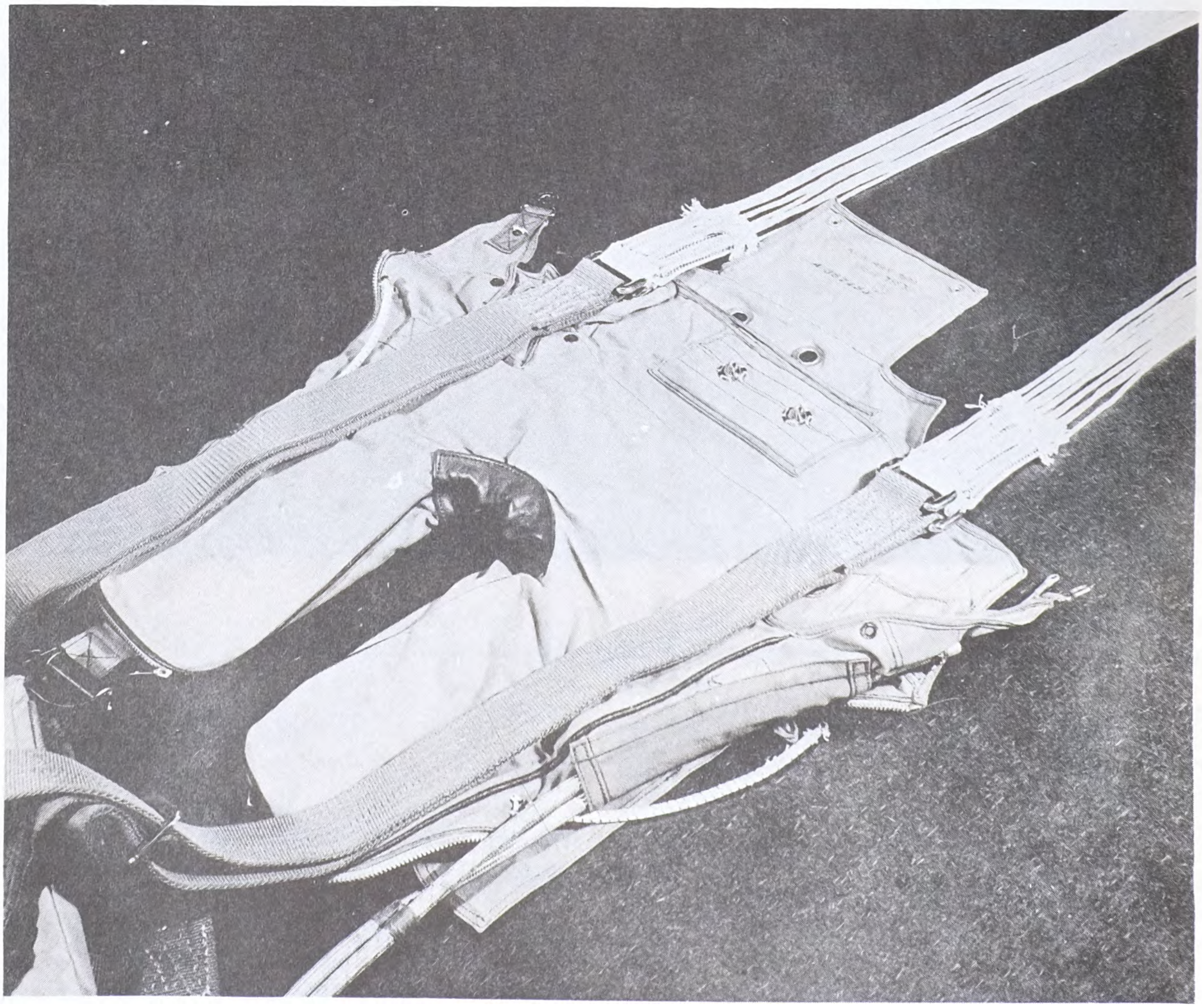


Figure 8-11.—Lift webs in position for tacking.

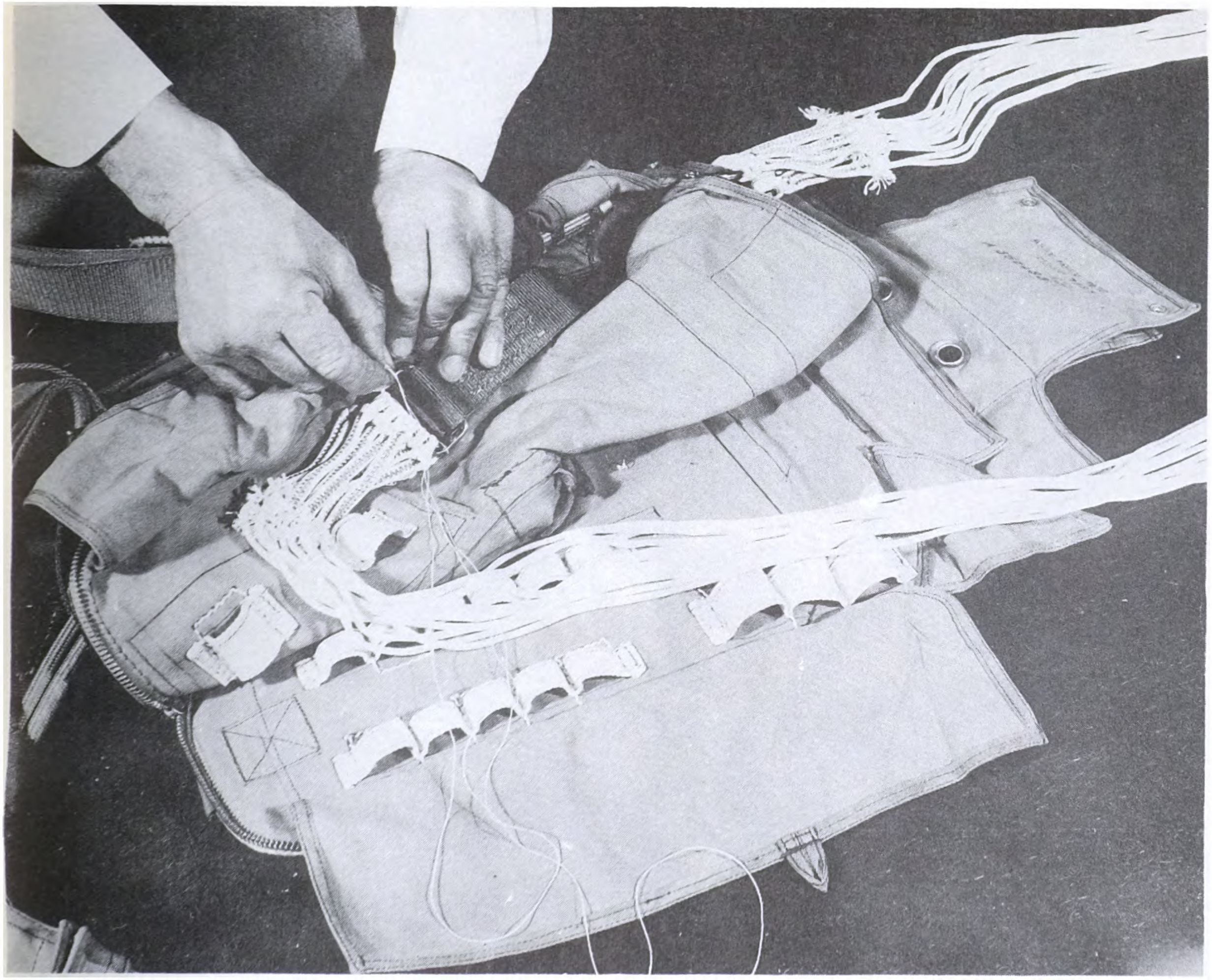


Figure 8-12.—Lift webs being tacked.

Bring the front flaps over the parachute, and tuck in each side of it, using the packing fid (fig 8-29).

Arrange the parachute withdrawal line so that it will emerge from the left side of the case toward the rear. Bring the inner flap over the parachute and place the front flap over and on top of it.

Place the long bar on the flaps in back of the locking cones with the bridle on the right. Pull the bridle through the grommet. (See fig. 8-30.)

Close the back flap, place the grommets over the cones, and insert temporary pins.

Close the left side flap (fig. 8-31), place the end tab over the locking cone on top of the grommet, and remove and replace the temporary pin over the side flap end tab.

Open the large (aft) ripcord handle flap and move the aft handle, checking that the motion is transmitted to the cable which emerges from the aft casing at the left side of the case. Replace the ripcord handle (fig. 8-32).

Slide the eye of the aft cable over the left ripcord pin. (See fig. 8-33.) It is essential that only the correct cable be attached here.

Holding the side flap end tab, remove the temporary pin and insert the left ripcord pin through the left locking cone. The parachute withdrawal line will now lie across the case and hang down on the right.

Folding and Stowing Pilot Chute

Lay the pilot parachute on the table with the apex down, and fold the skirt edges inward on

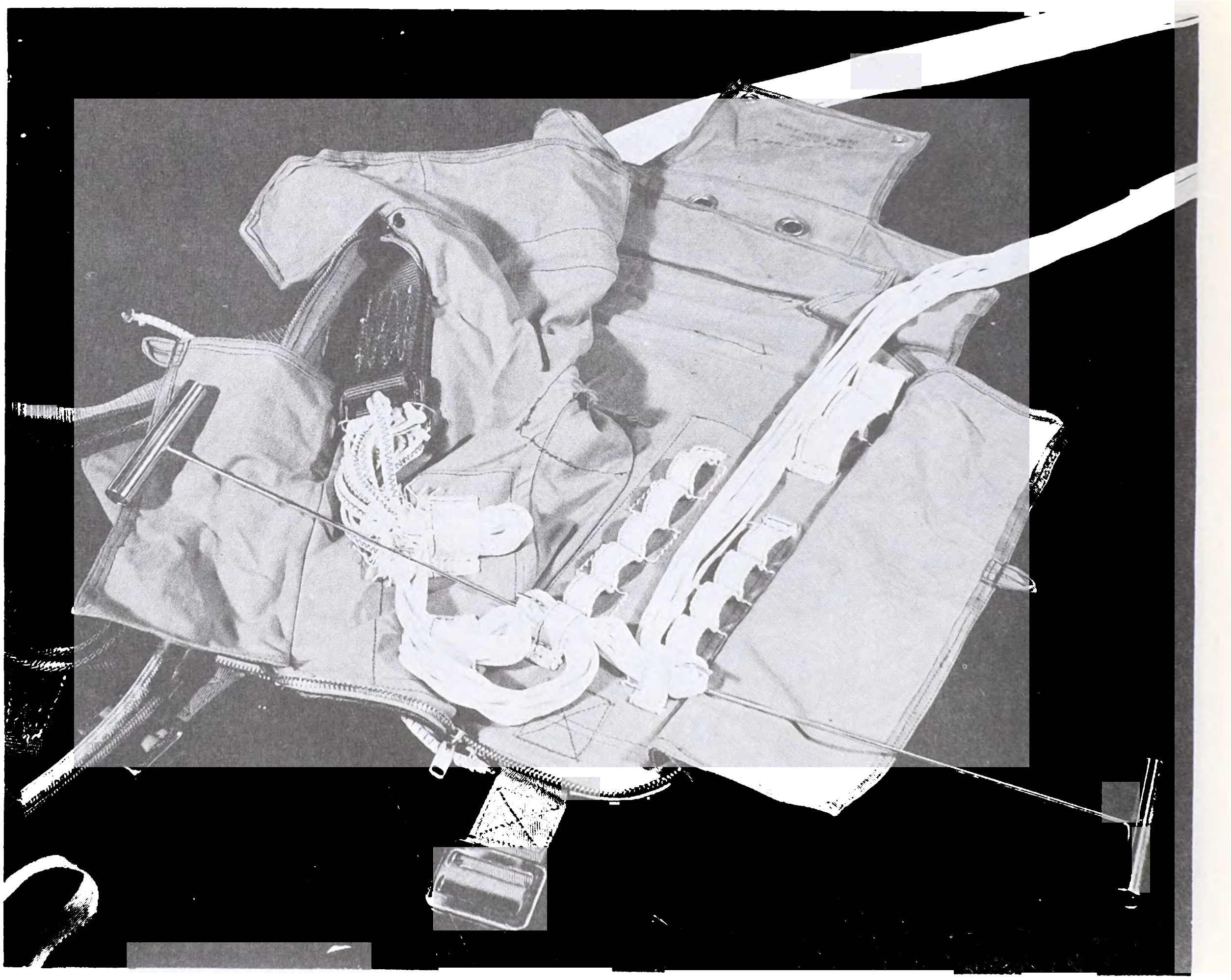


Figure 8-13.—Bights 3 and 4 taken.

top of the wire frame. Loop the shroud lines and route them over one corner of the parachute. The shroud line loop should extend about 2 inches beyond the corner.

Bring the corners of the pilot parachute together (fig. 8-34), insuring that the shroud lines do not slip.

Insert the pilot parachute into the parachute case on the right side, entering the apex first. (See fig. 8-35.) It must go on top of the pilot parachute (kicking) board, and under the black flap. NOTE: If a temporary pin is installed on the right side, removing the pin will make this operation easier.

Insert a temporary pin through the right cone, holding down the back flap. In doing this, it may be necessary to push the pilot parachute back away from the cone. Fold all of the bridle in three accordion folds, and stow it under the right side of the back flap.

Close the right-side flap, remove the temporary pin, and place the end tab over the right locking cone. Install the right ripcord pin through the cone over the side flap tab. During this operation, use care that the left ripcord pin does not disengage from its cone, as the cable between the pins is quite stiff. The parachute withdrawal line will now extend over the right side of the case.

Safe-tie the right ripcord pin by passing a strand of size A thread under the pin and around the cone. Bring the ends of the thread together and secure to the cable behind the serving for the pin, using three half hitches. If desired, a

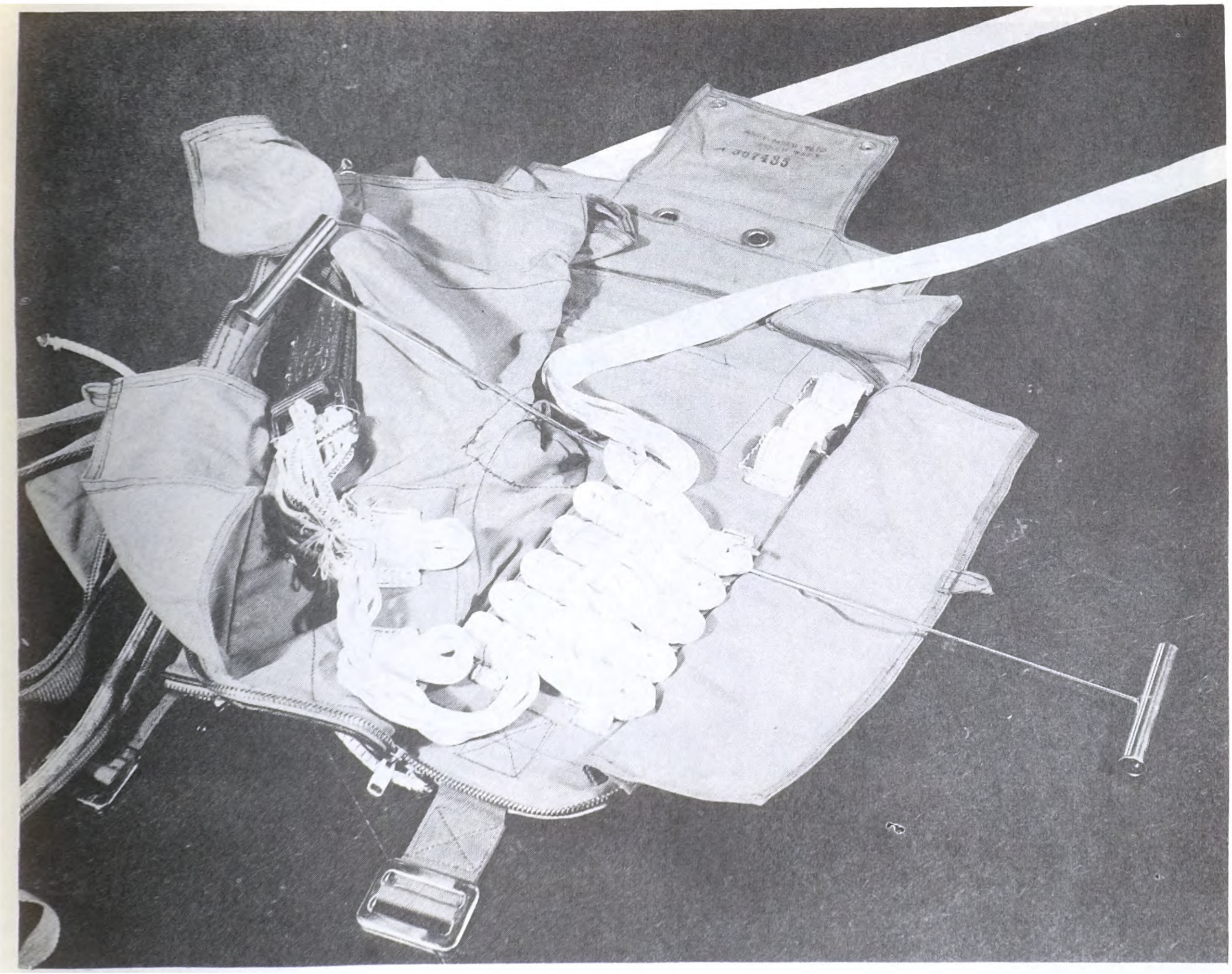


Figure 8-14.—Bights 3 through 13.

lead seal may be placed on the end of this thread with sealing pliers.

Connect one elastic on each side flap, making sure the hooks point inward. Also, check that the left elastic is to the rear of the ripcord casing assembly, as shown in figure 8-36. Connect two elastics on the back flap, making sure the hooks point inward. Pull up the zippers on each side and tie the slide fasteners to the adjacent grommets in the case, using a single loop of B thread, and securing with a square knot.

Fitting Slide Disconnect

Fold the stiffened flap down over the parachute withdrawal line and fold the line back to the left on top of the flap.

Arrange the slide disconnect line to emerge from the left side of the case. The line must pass through the sleeve of the slide disconnect. The large pin of the slide disconnect must point toward the right side, as shown in figure 8-37.

The end of the slide disconnect line must pass through the end loop of the parachute withdrawal line from back to front. The end loop of the slide disconnect line must then pass over the large pin of the slide disconnect fitting. (See fig. 8-38.)

Open the striped flap covering the slide disconnect ripcord handle, and move the handle, checking that the motion is transmitted to the cable, which emerges from the forward casing at the left side of the case. Check that both ripcord handles are installed in their pockets with the convex sides outward (fig. 8-39).

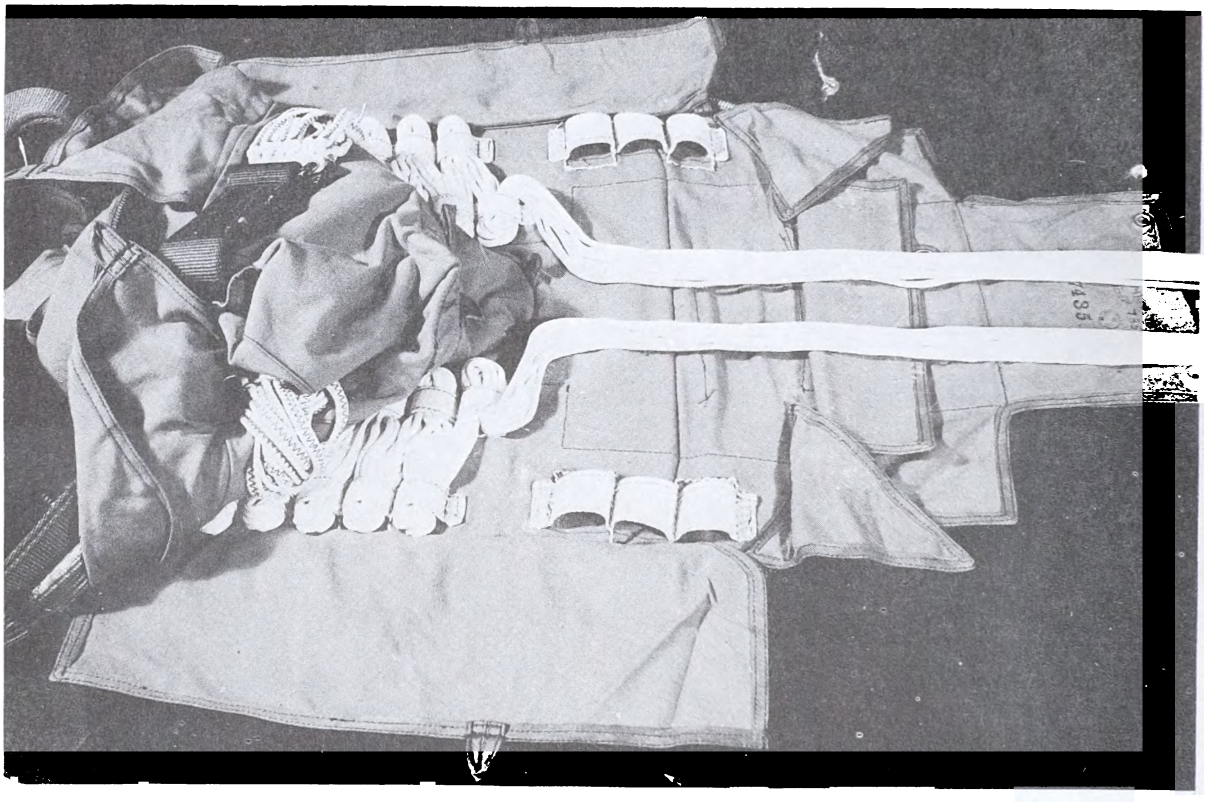


Figure 8-15.—Junction bights off center.

Replace the striped flap. Replace the large flap so that it passes through the personnel parachute ripcord handle and completely covers the aft handle. (See fig. 8-40.)

Slide the eye of the forward cable over the small pin of the slide disconnect and pull the slide disconnect line to the left through the fitting, in order to tighten the connection, as shown in figure 8-38. Safe-tie the slide disconnect by passing a single loop of 16 x 4 thread around the parts as indicated and tie with a square knot.

Close the top outer flap, insuring that the grommets of the stiffened flap engage the press fastener studs.

Pass one parachute restraint strap through the sewn loop on the slide disconnect line on the left, and pass the other through the loop of the parachute withdrawal line on the right—in that order. The ring ends of the parachute restraint straps must be forward, as shown in figure 8-41.

Pass the parachute restraint straps around the pack and tie them together with a temporary cord to prevent the ends from flapping. (See fig. 8-42.) This step is not necessary, if the parachute and the harness are to be installed on the seat immediately.

Arranging Harness

Check that the two straps between case and harness are buckled, as shown in figure 8-43.

Check that the snap fasteners on the back pad are secure. Check that the two harness straps, which terminate in loops, pass upward through the slot in the seat cushion. Check that the harness quick release box is locked. If not, turn the knob counterclockwise to lock. Check that the lugs of the two harness straps (blue) are passed through the loops of the straps above the cushion, and that they are plugged into the lower part of the quick release box. Check that the lugs of the two upper straps are plugged into the upper part of the quick release box. Make out the Parachute Inspection Card and place it in the pocket in the case.

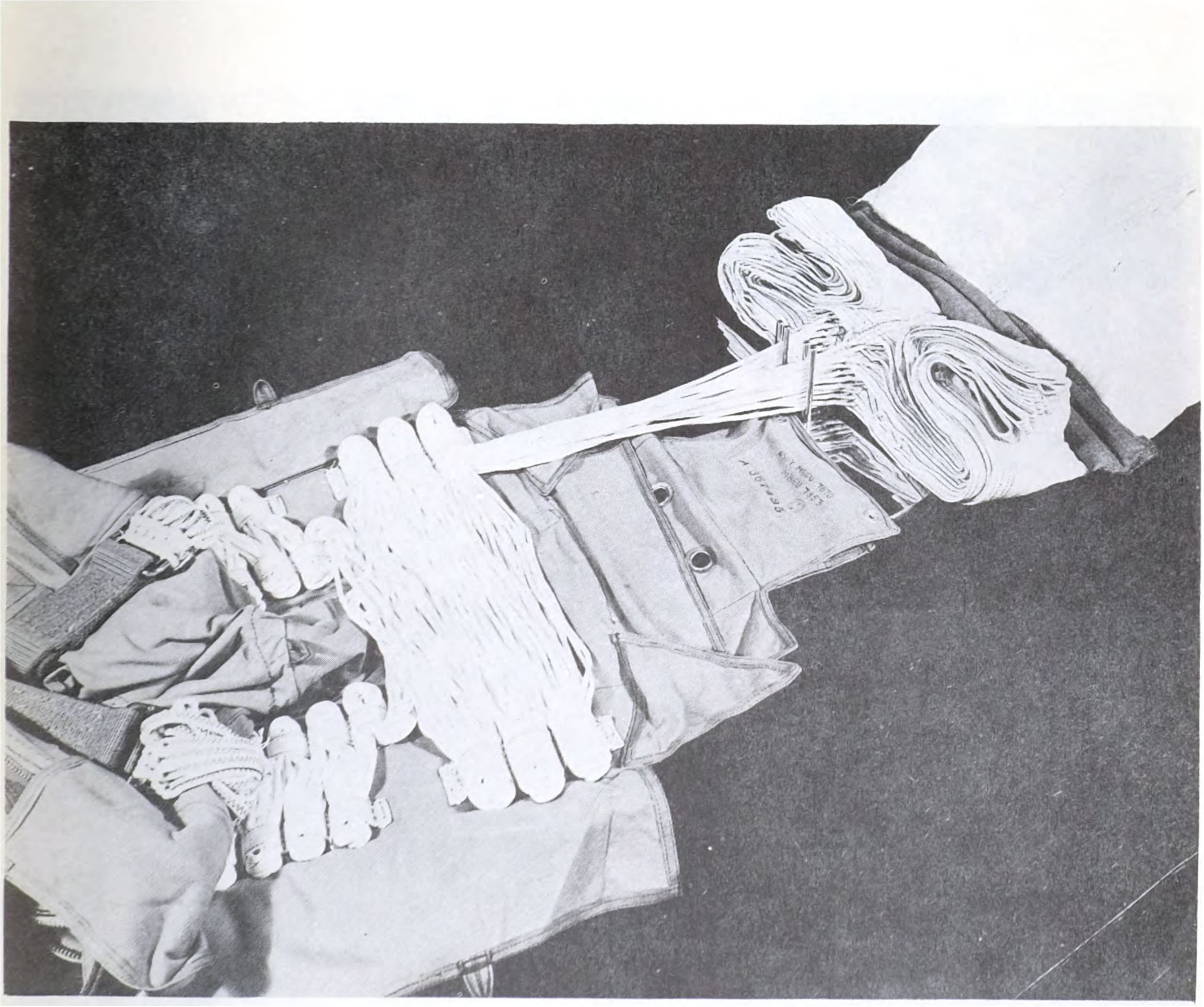


Figure 8-16.—Bights 14 through 19 complete.

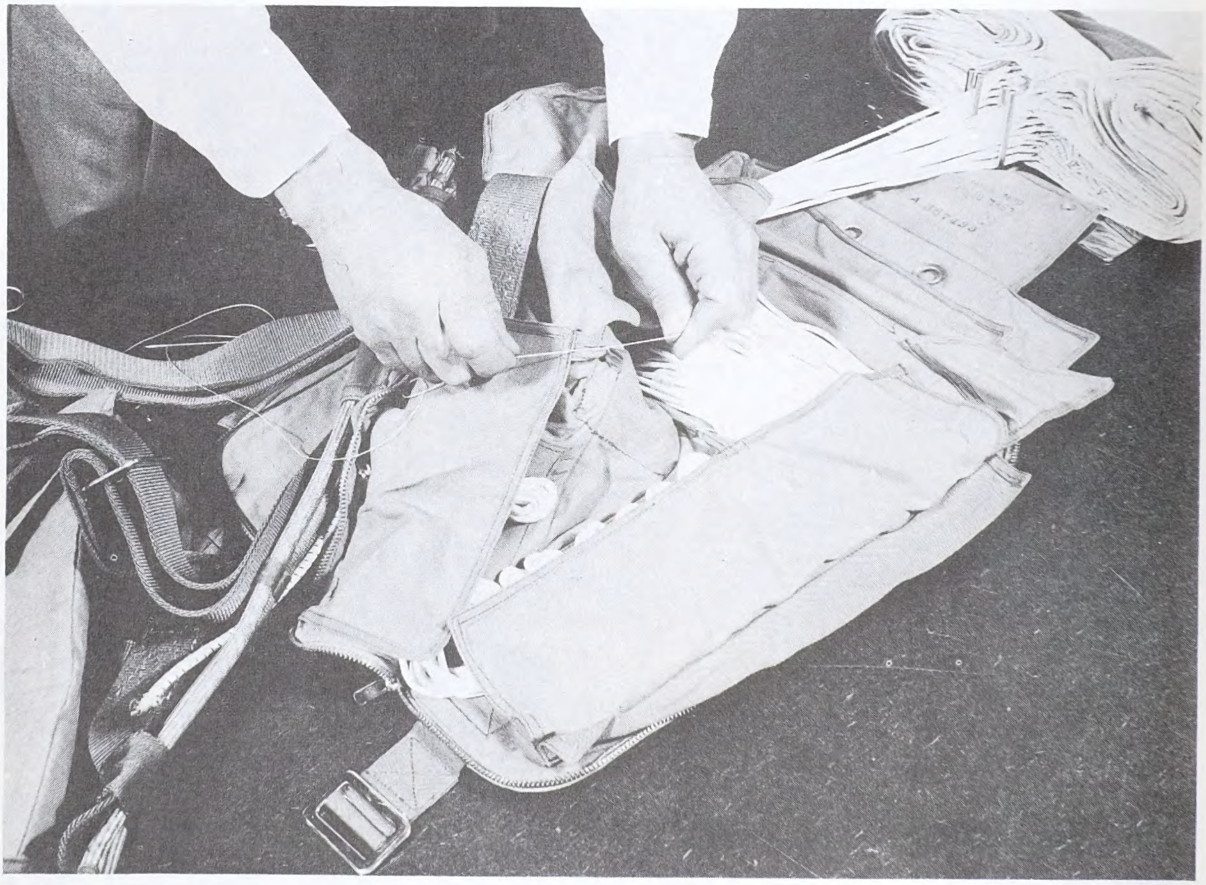


Figure 8-17.—Closing protector flap over hesitator loops Nos. 1 and 2.

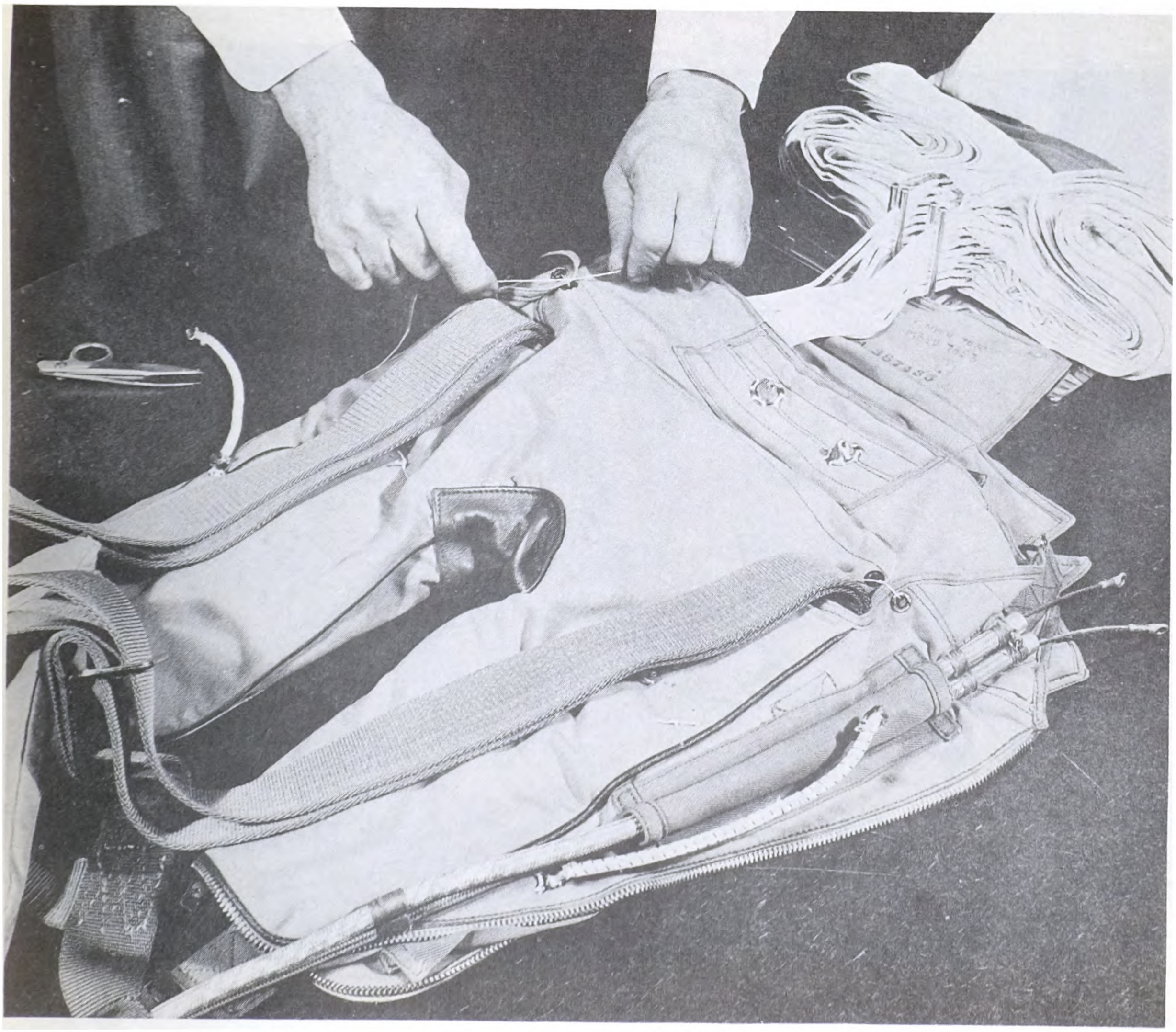


Figure 8-18.—Securing grommets.

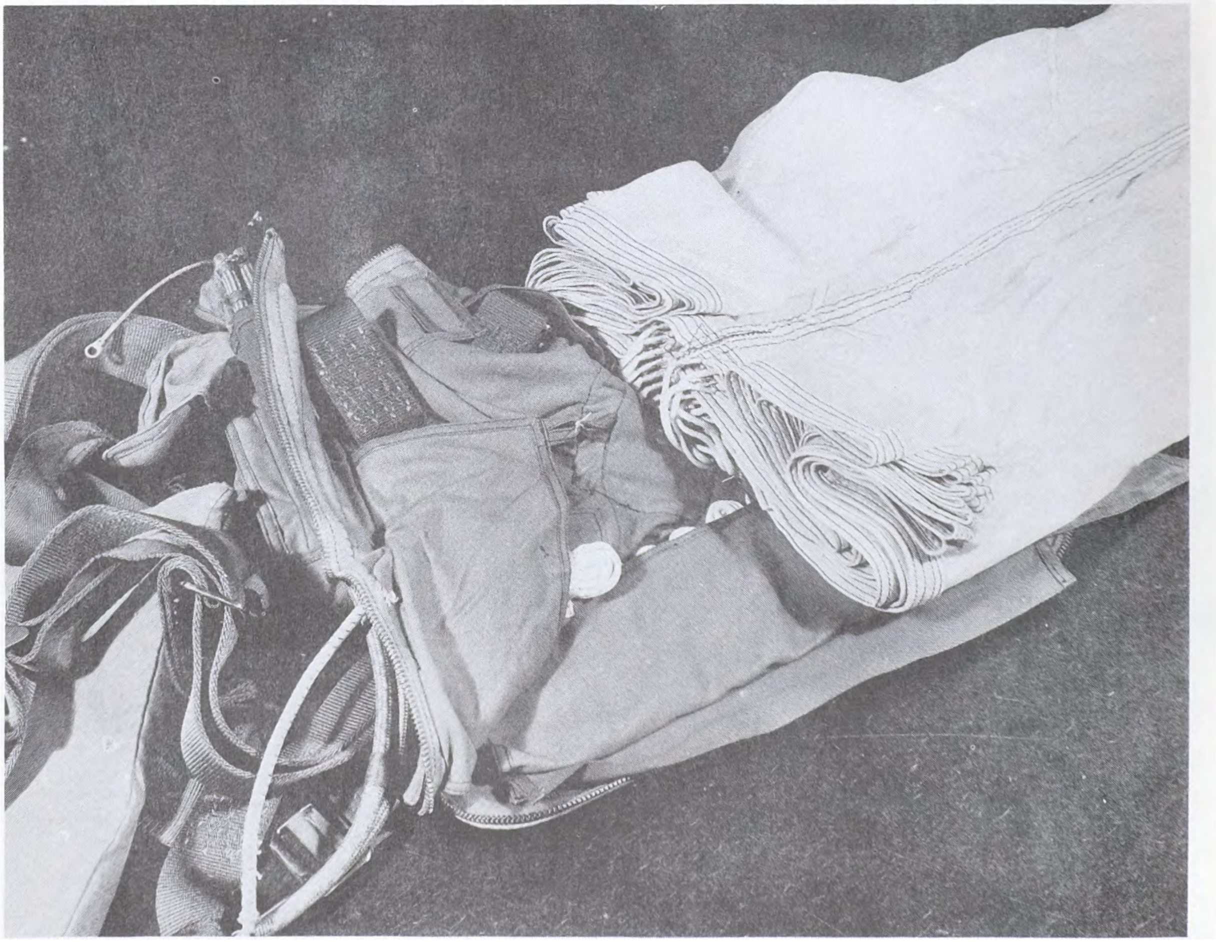


Figure 8-19.—Skirt touching arch of horseshoe.

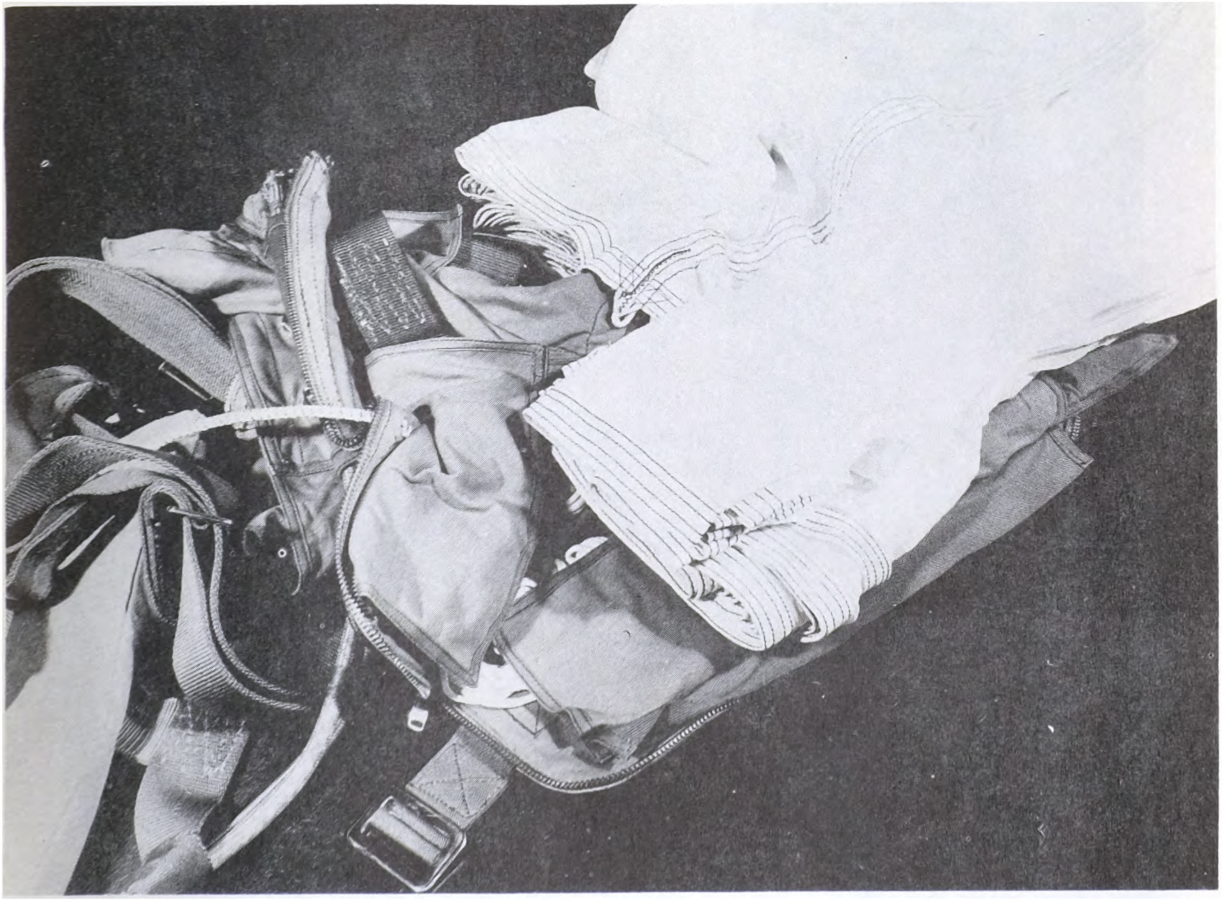


Figure 8-20.—Skirt 4 inches from bottom.

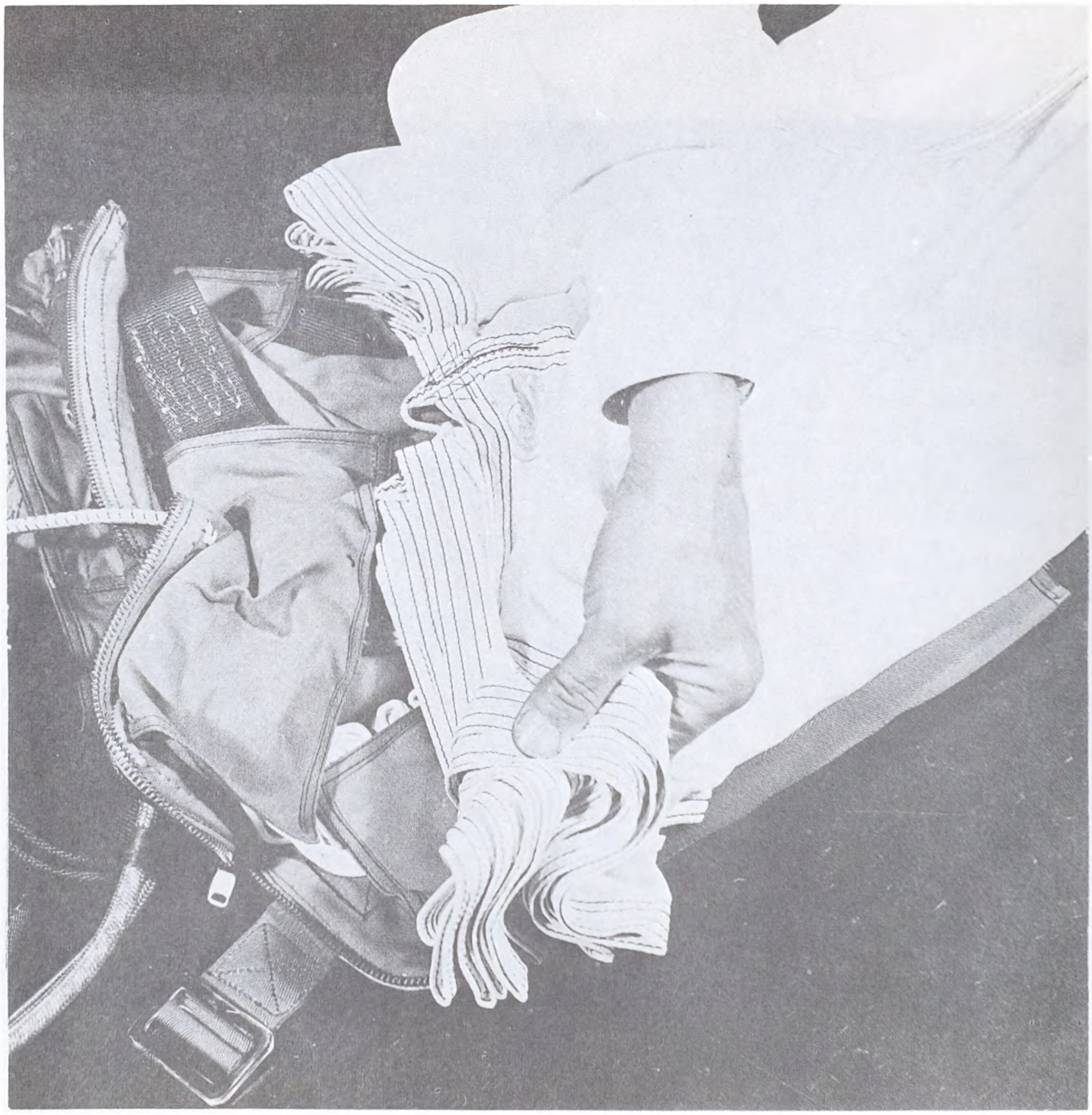


Figure 8-21.--Half skirt pulled to bottom in taper.

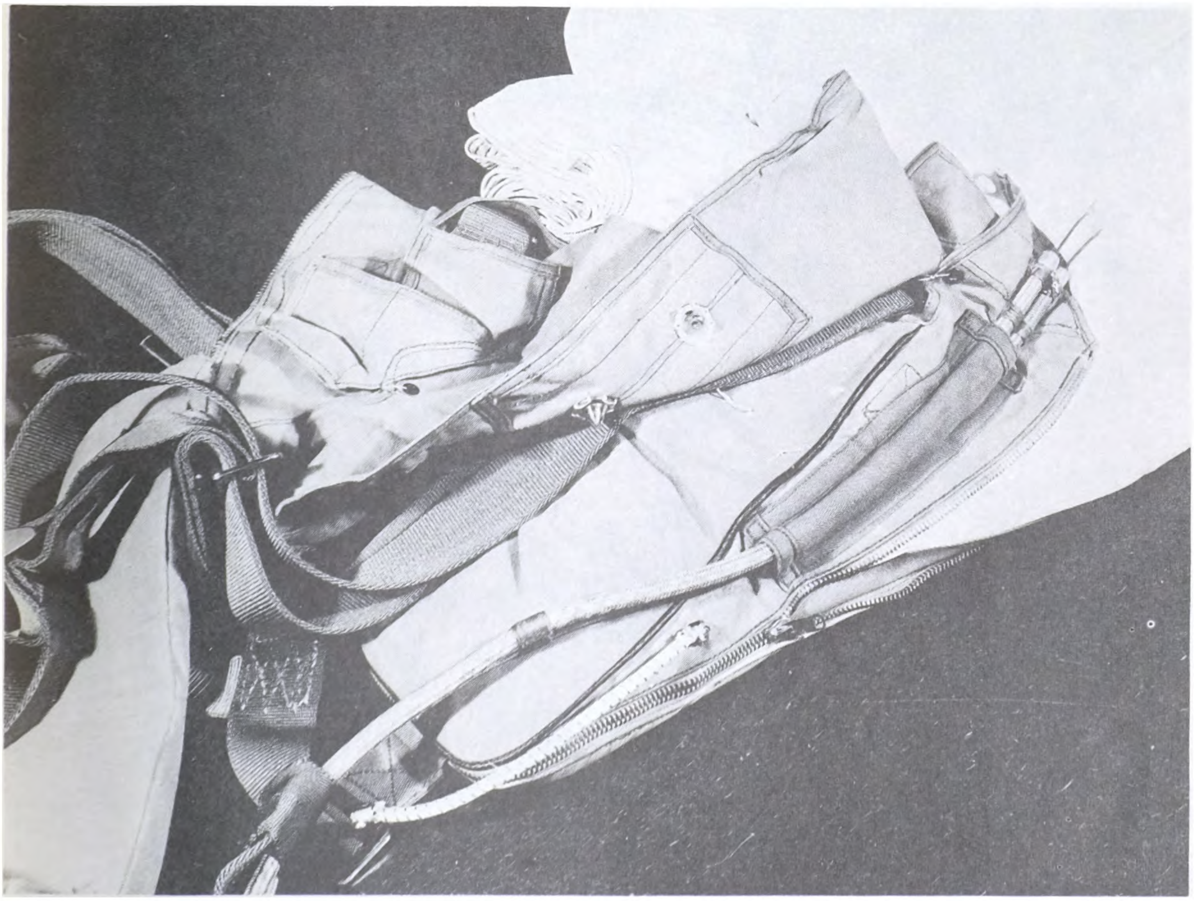


Figure 8-22.—Closing zipper.

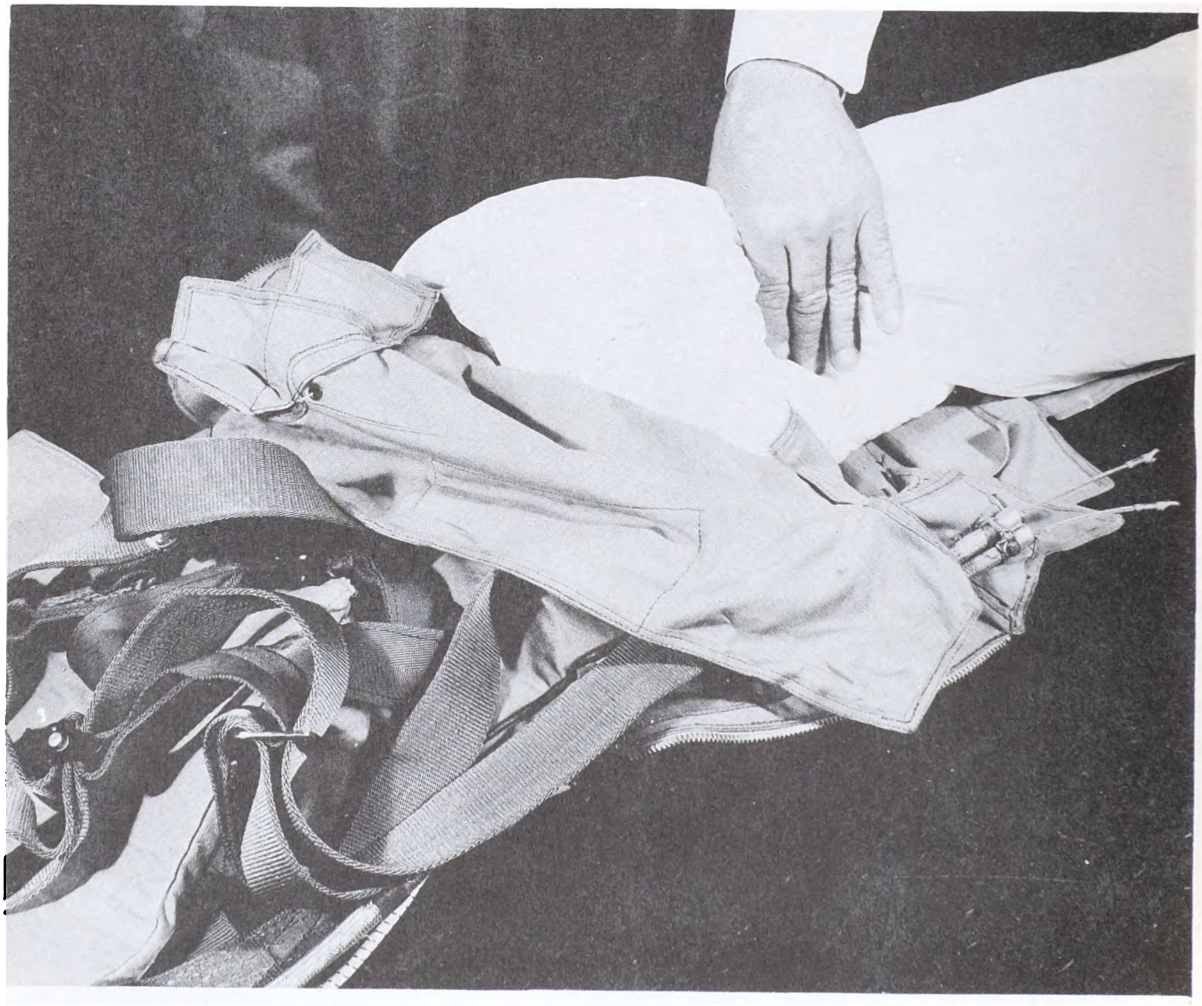


Figure 8-23.—Bringing first fold to side of case.

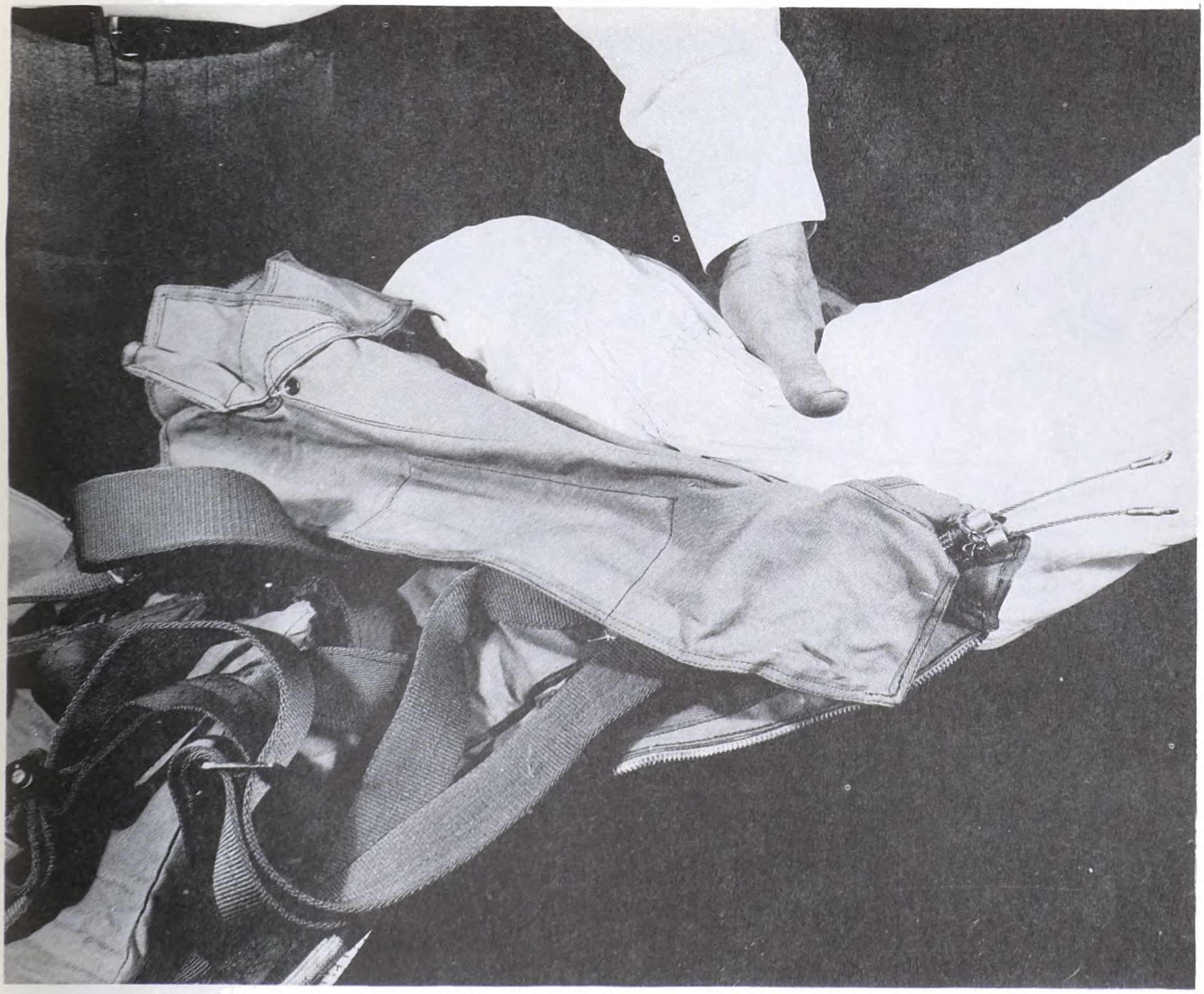


Figure 8-24.—First accordion fold to right side of pack.

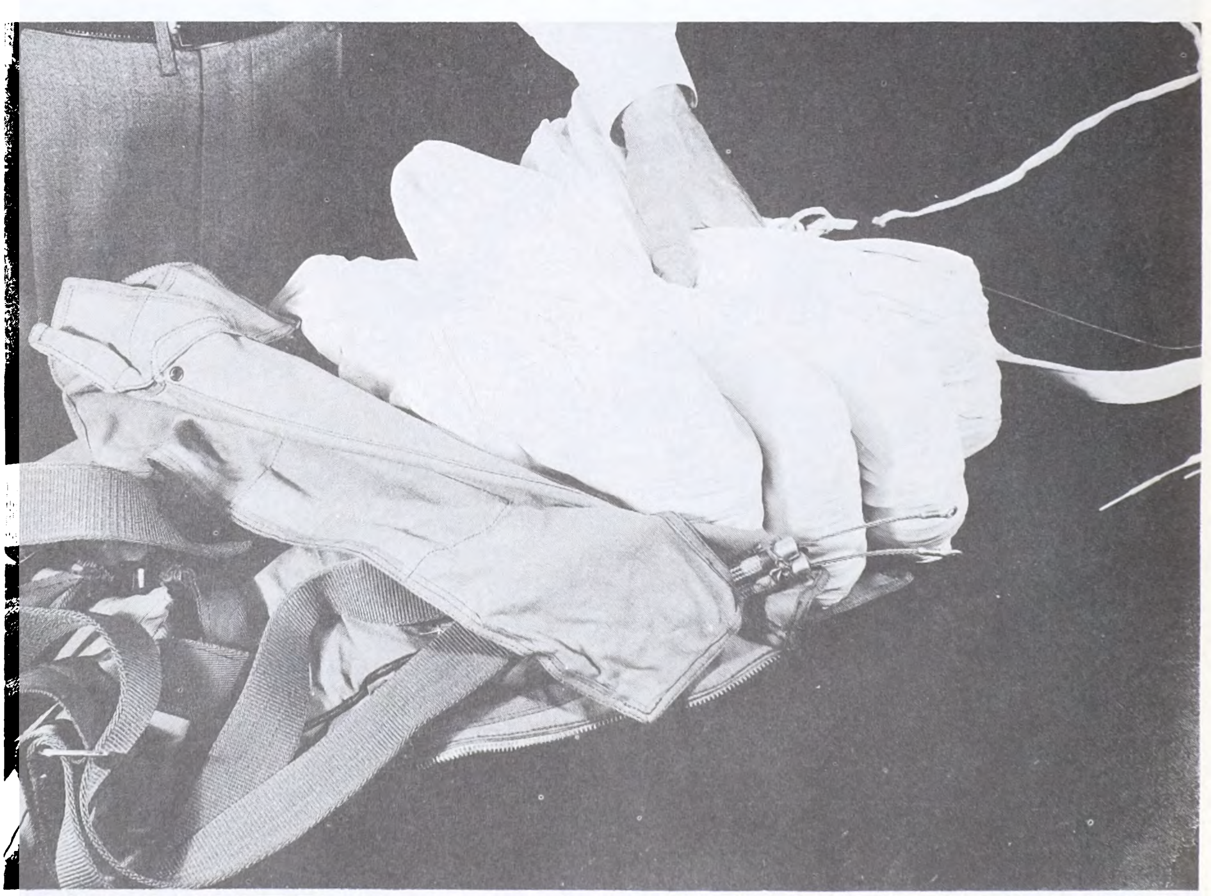


Figure 8-25.—Completion of accordion folds.

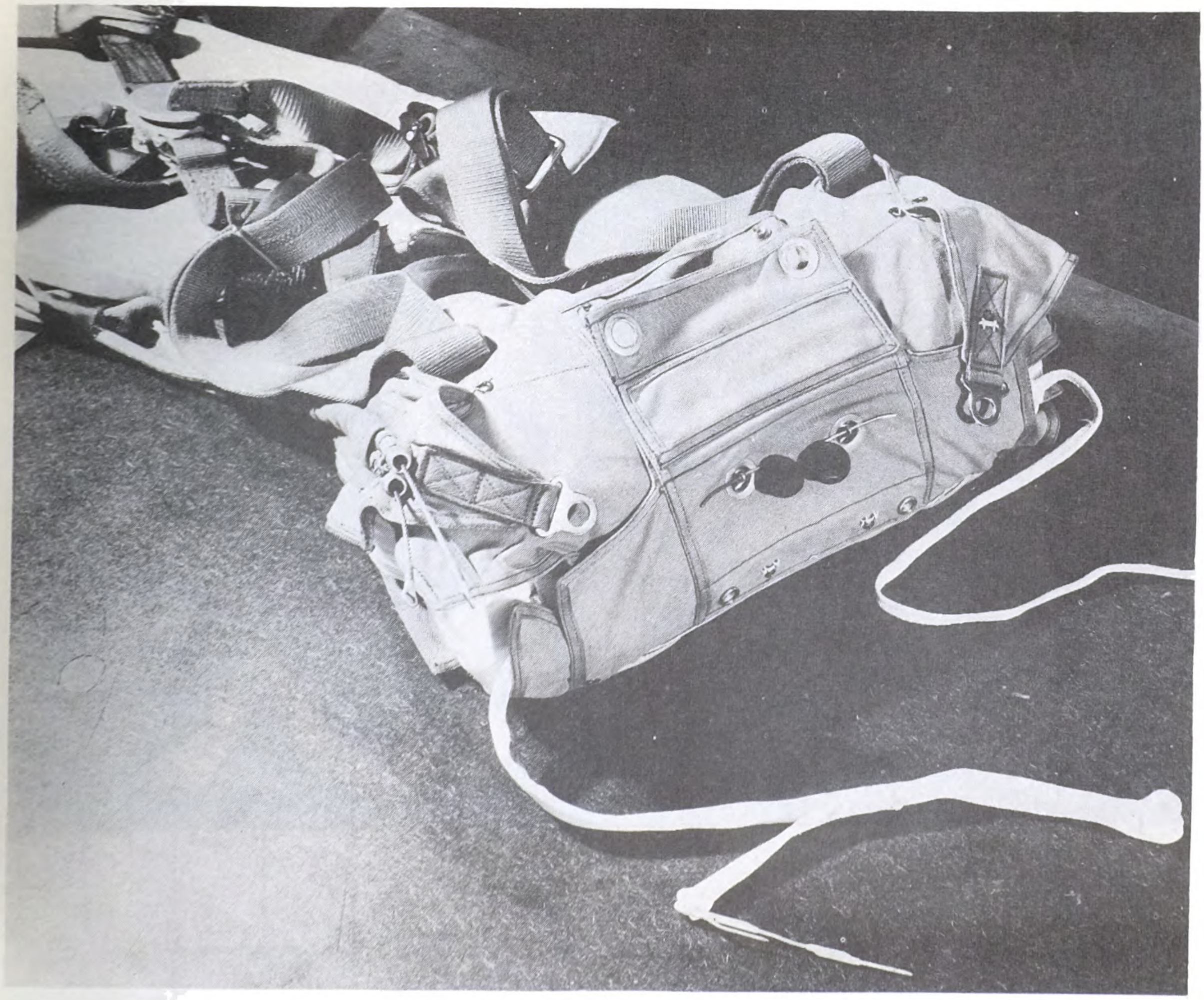


Figure 8-26.—Securing back flap.

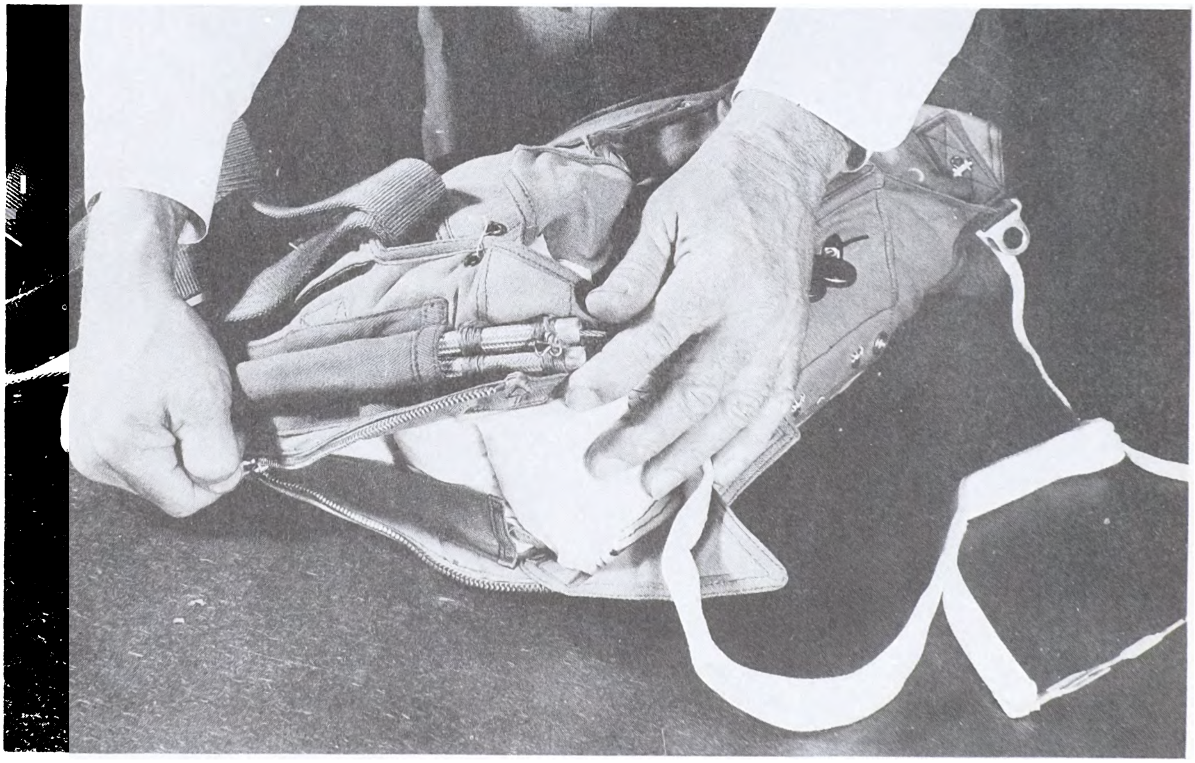


Figure 8-27.—Closing zippers on each leg.

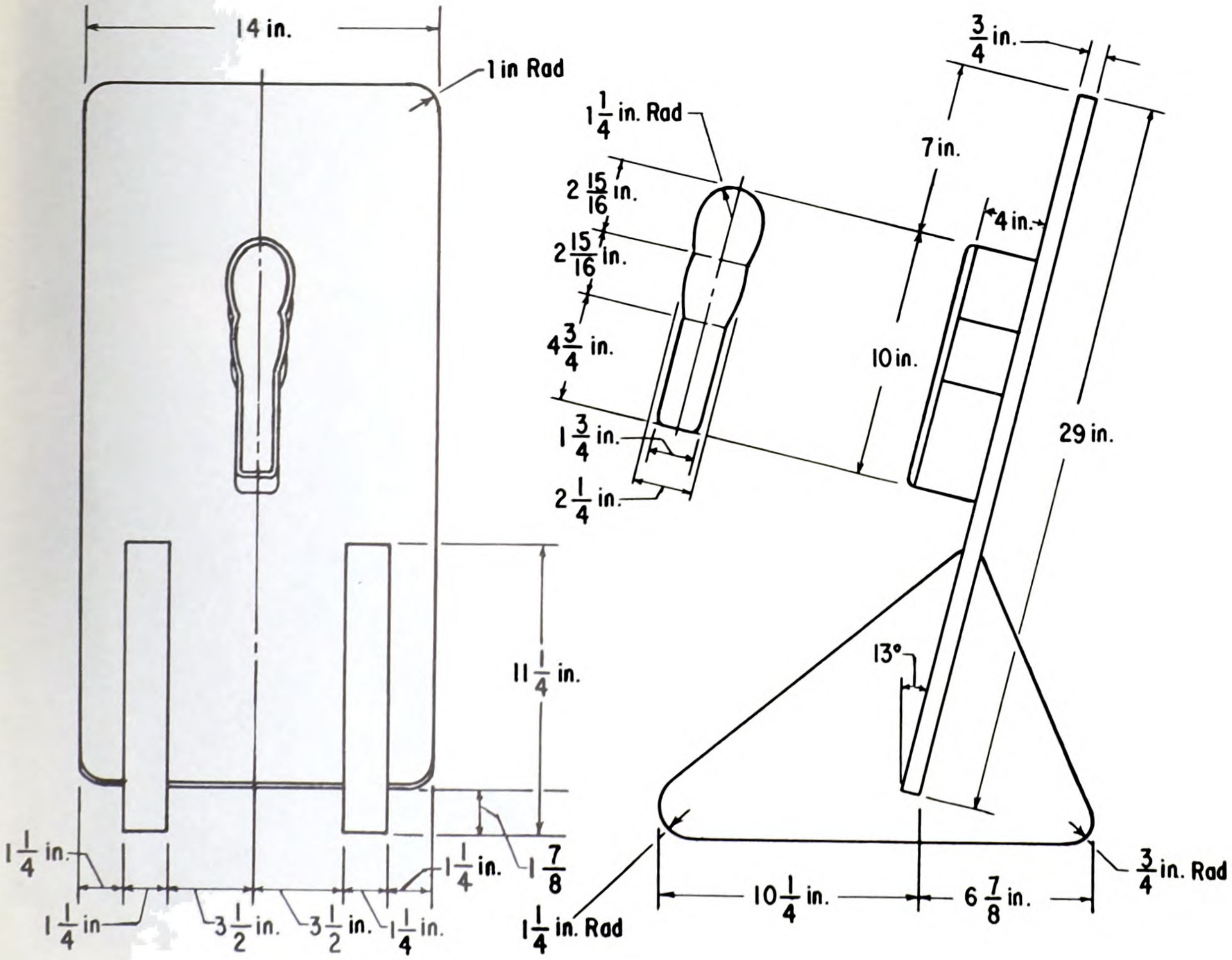


Figure 8-28.—Holding stand.

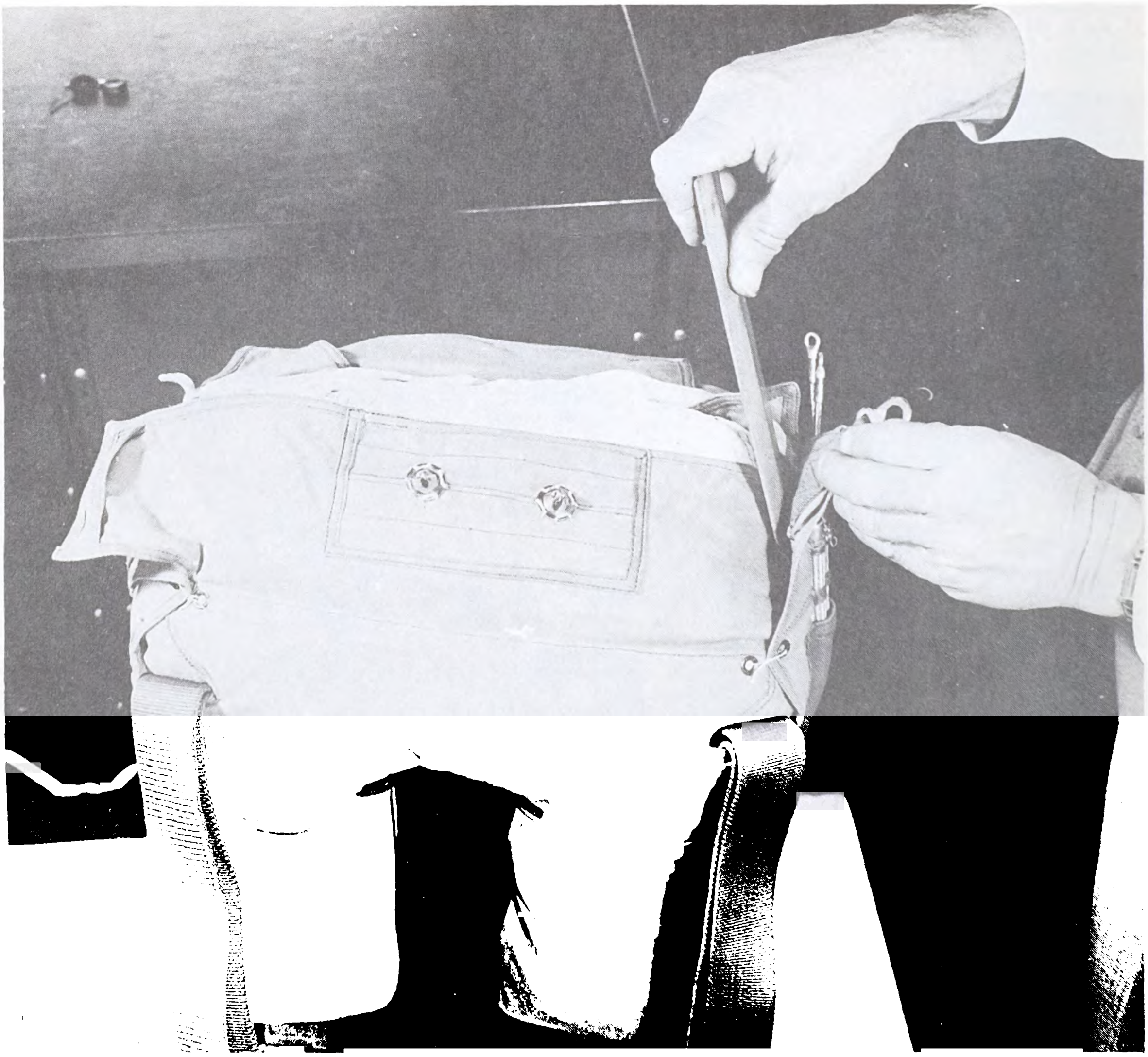


Figure 8-29.—Tucking side flaps.

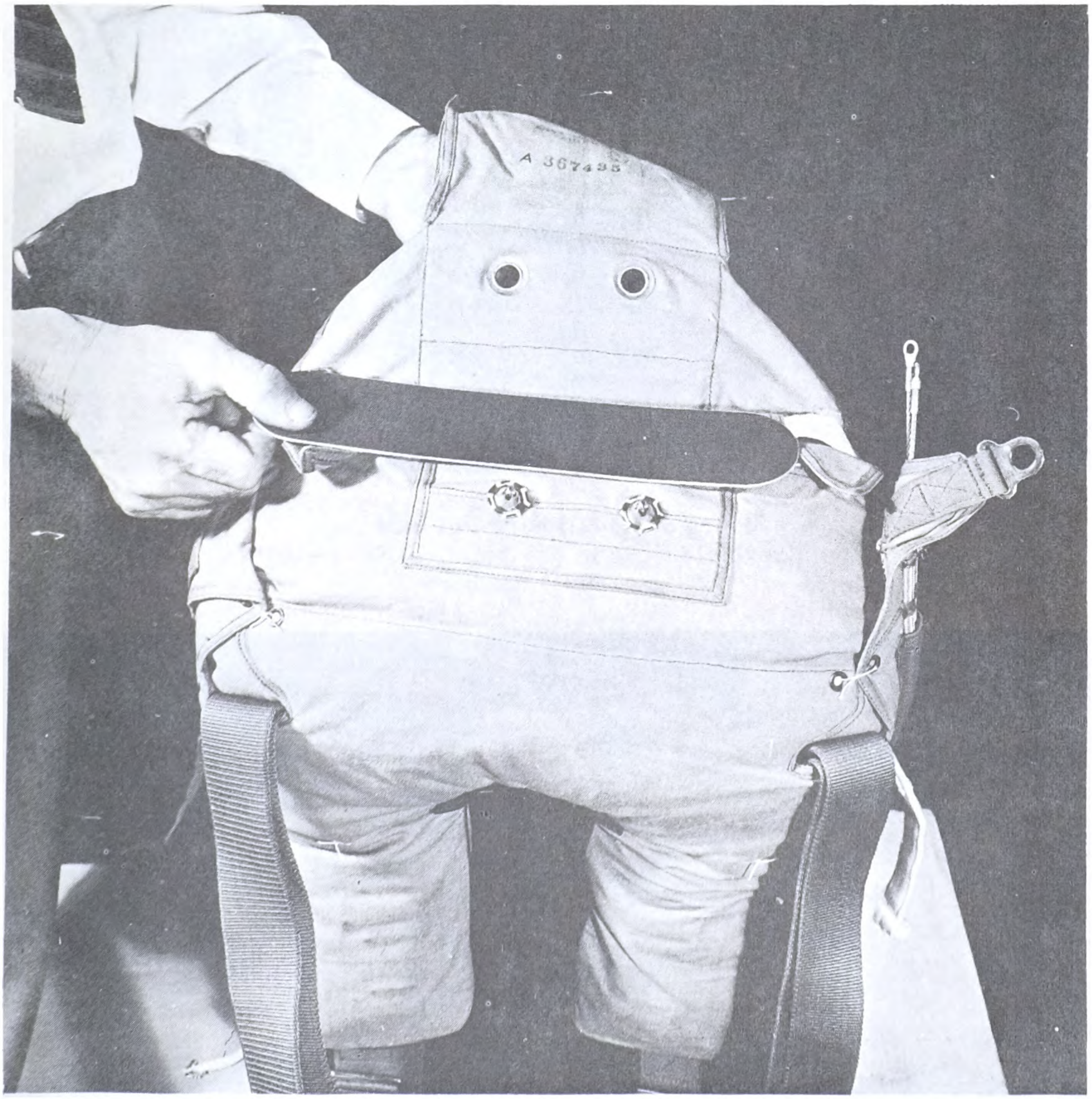


Figure 8-30.—Placing long bar between cones and grommets.

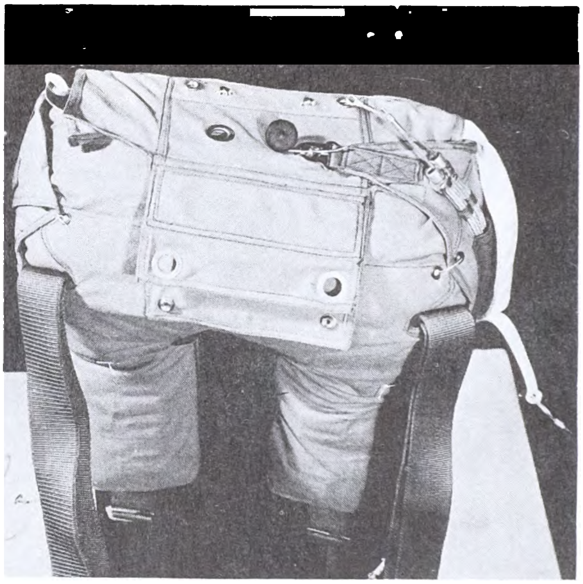


Figure 8-31 —Closing left side flap.

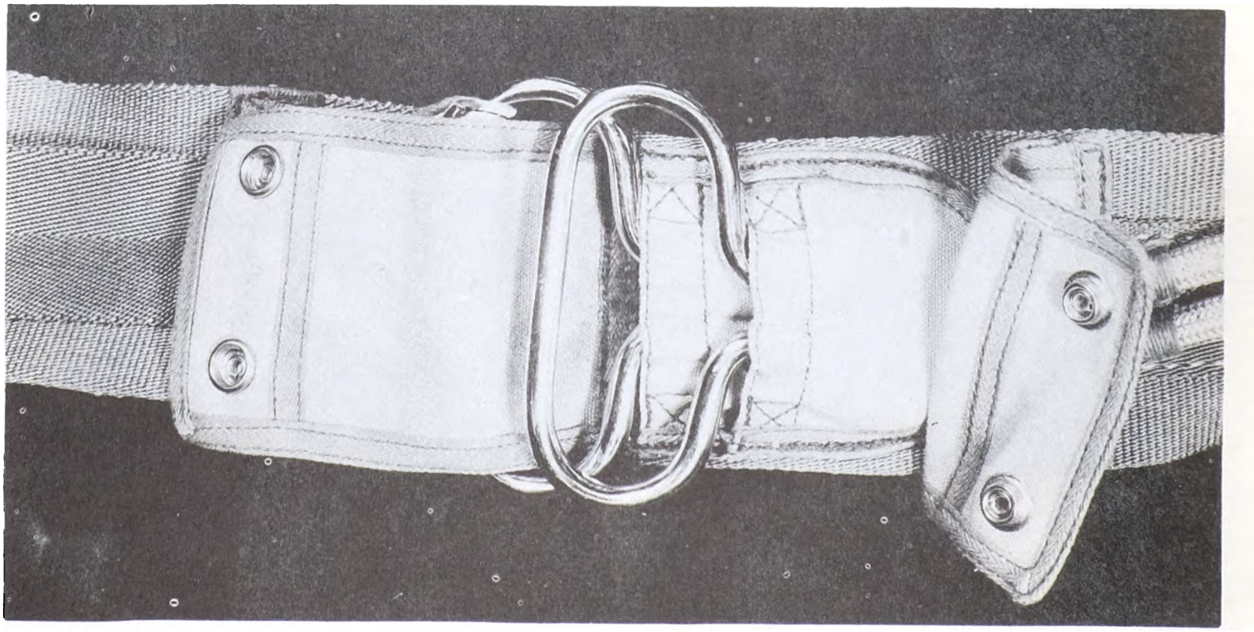


Figure 8-32.—Replacing ripcord handle.

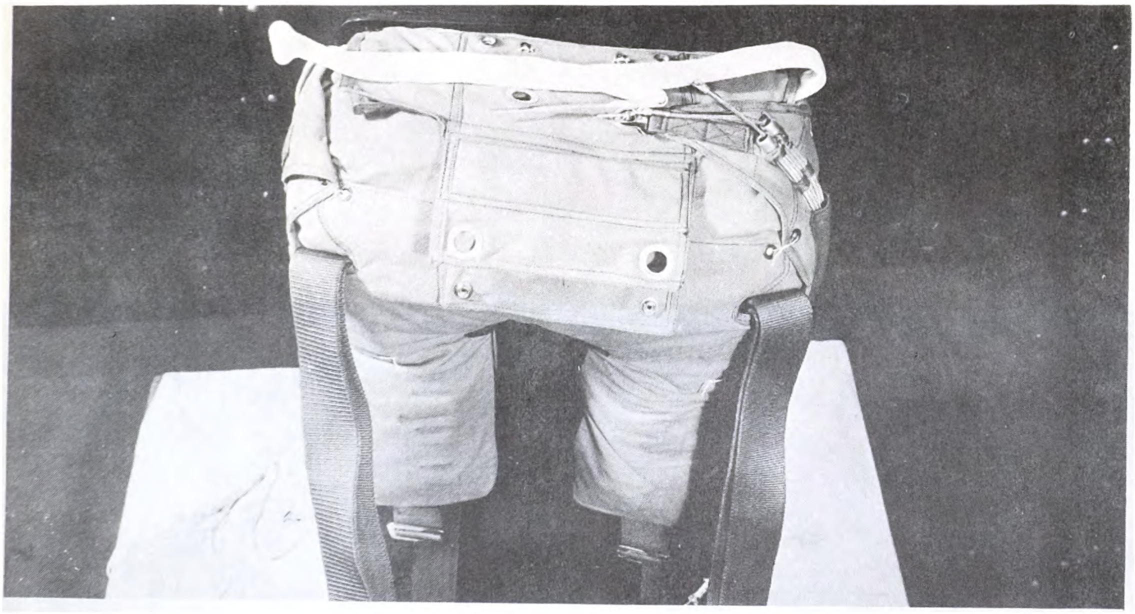
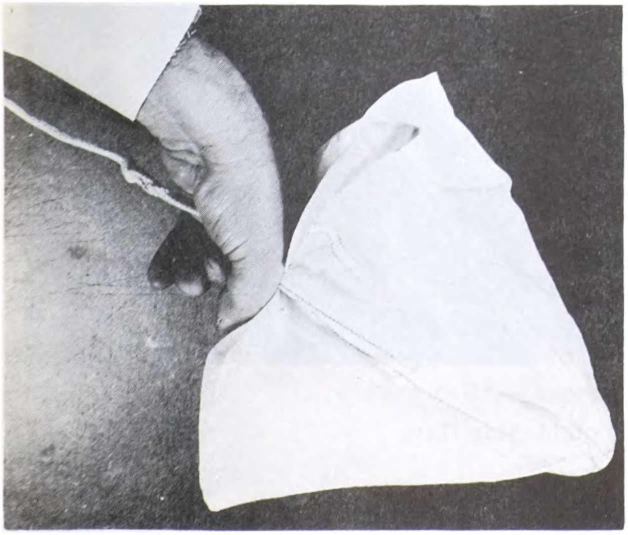


Figure 8-33.—Sliding eye of aft cable over rip-cord pin.



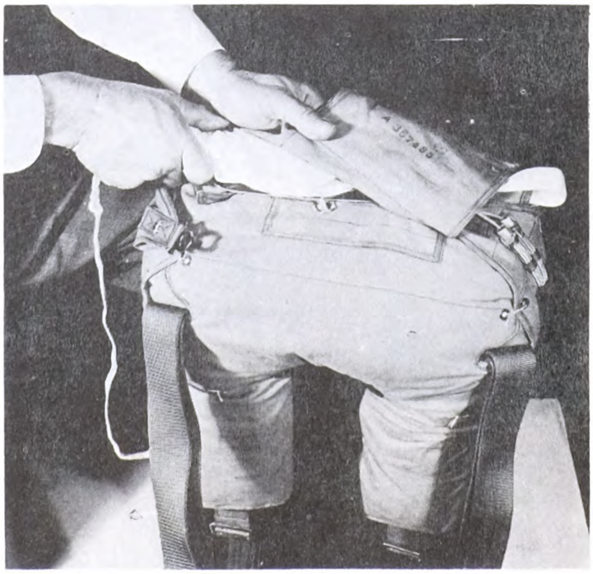


Figure 8-34.—Bringing corners together.

Figure 8-35.—Inserting pilot chute.

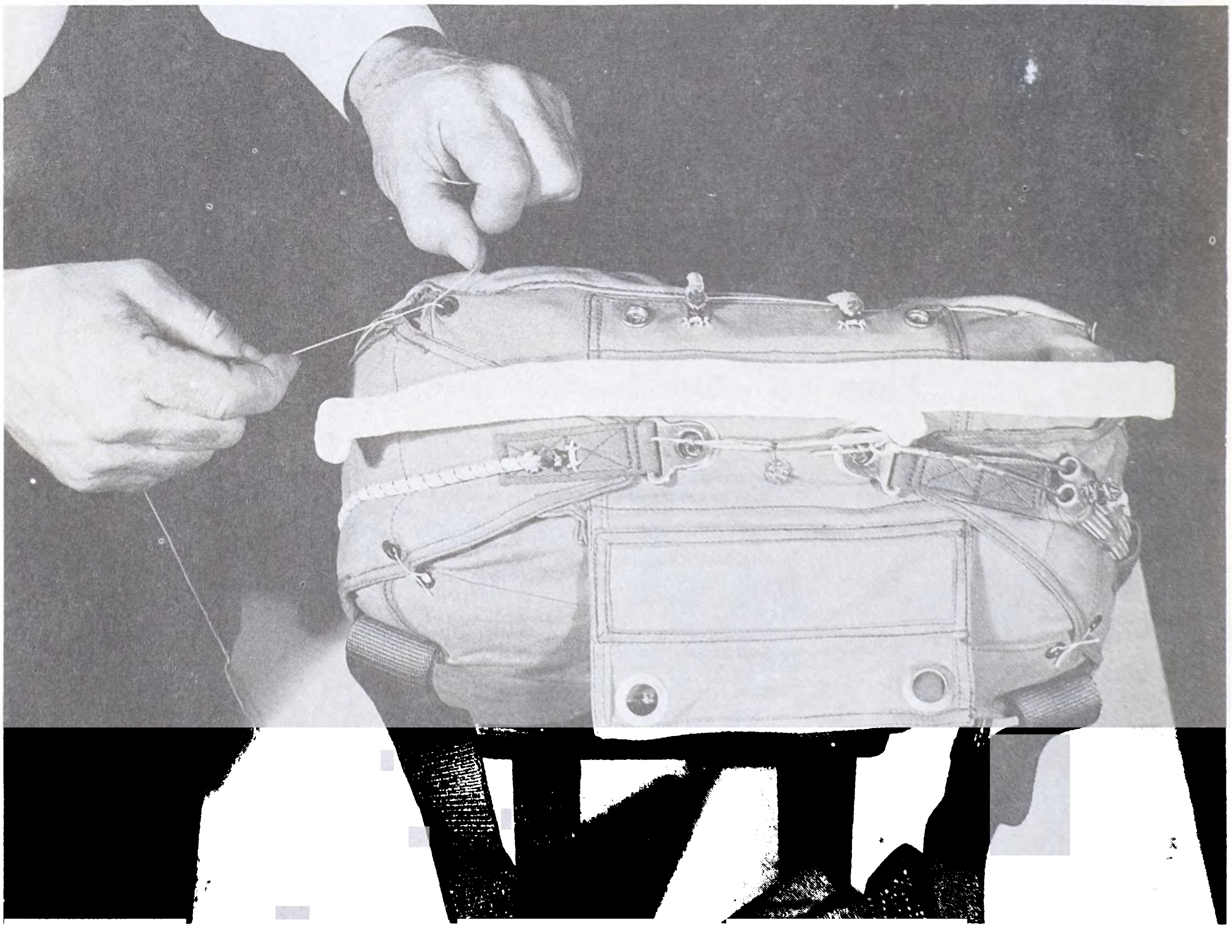


Figure 8-36.—Closing right-side flap.

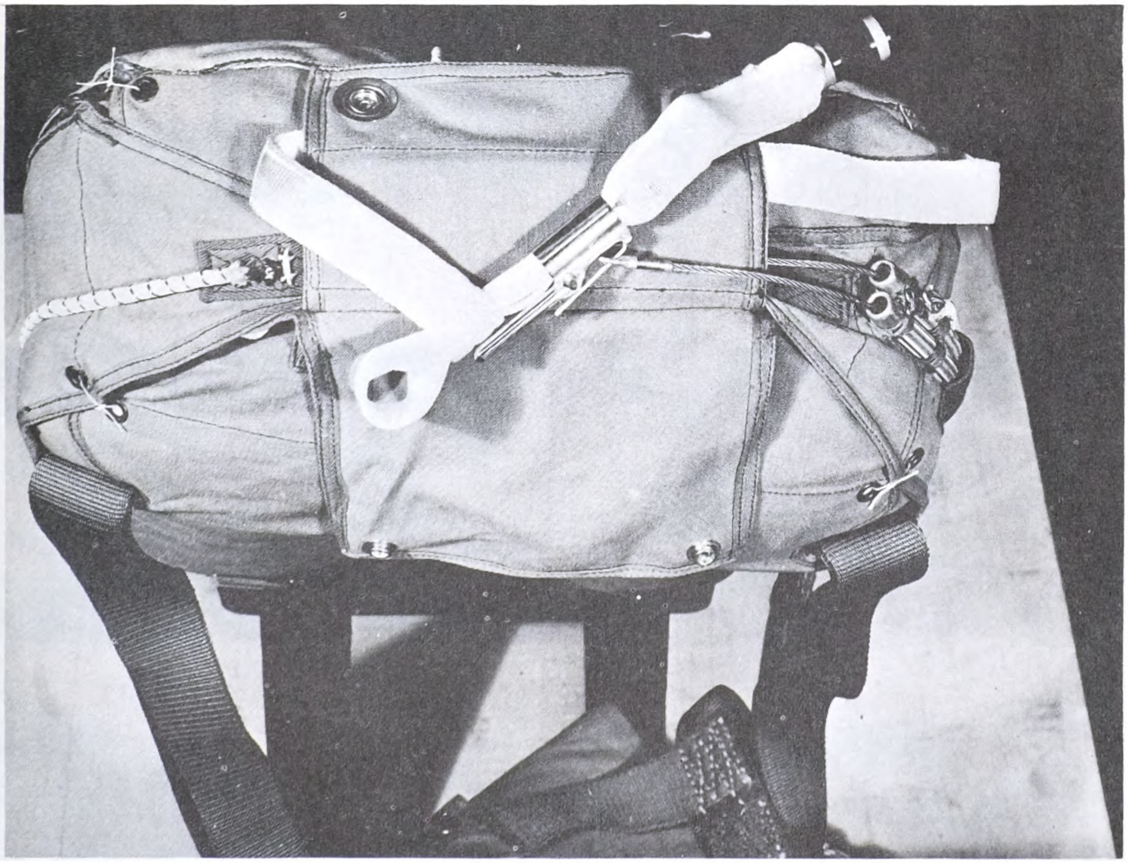


Figure 8-37.—Arranging slide disconnect line.

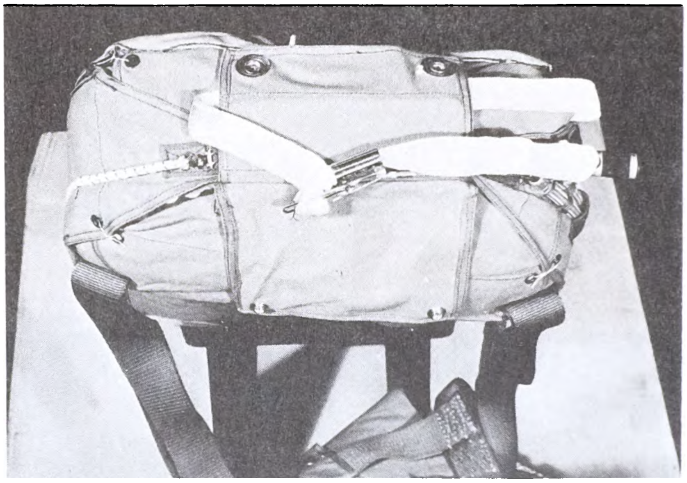


Figure 8-38.—Correct position of slide disconnect line.

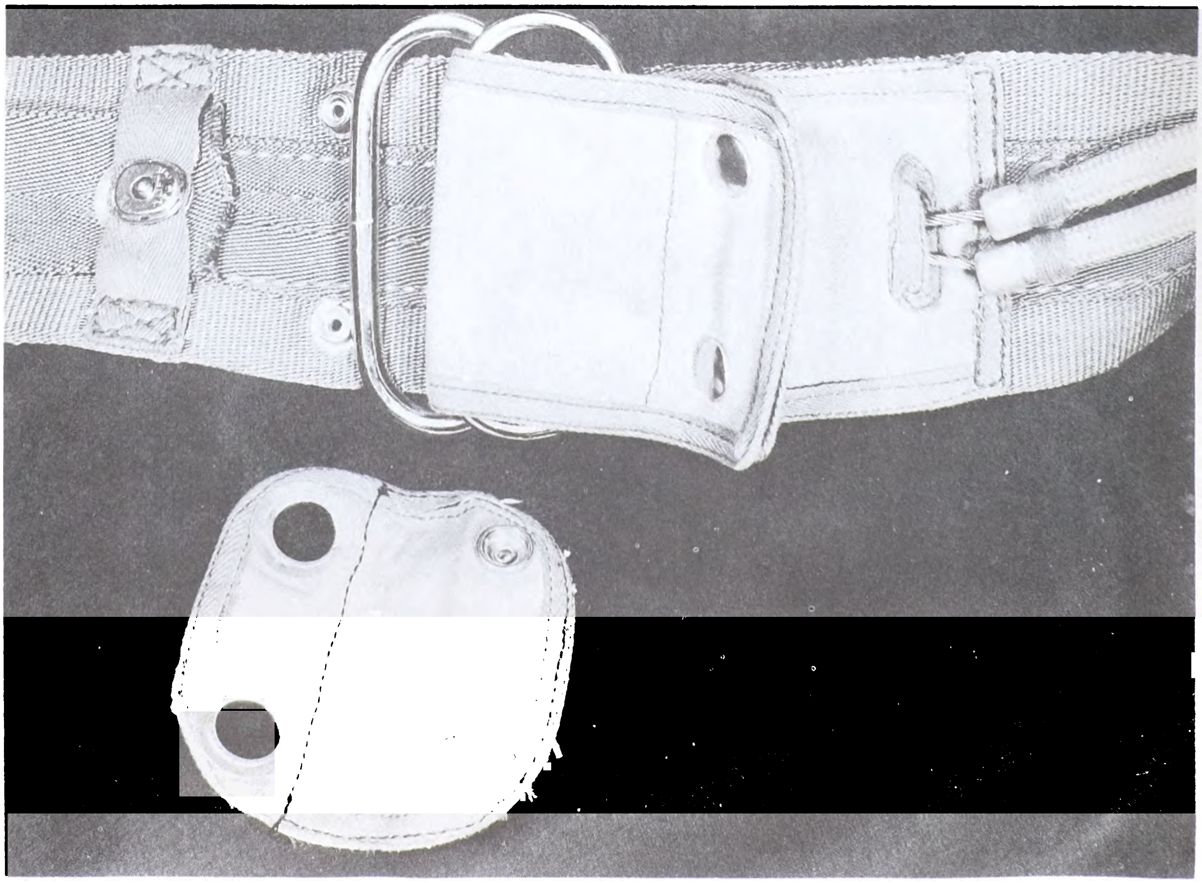


Figure 8-39.—Checking ripcord handles.

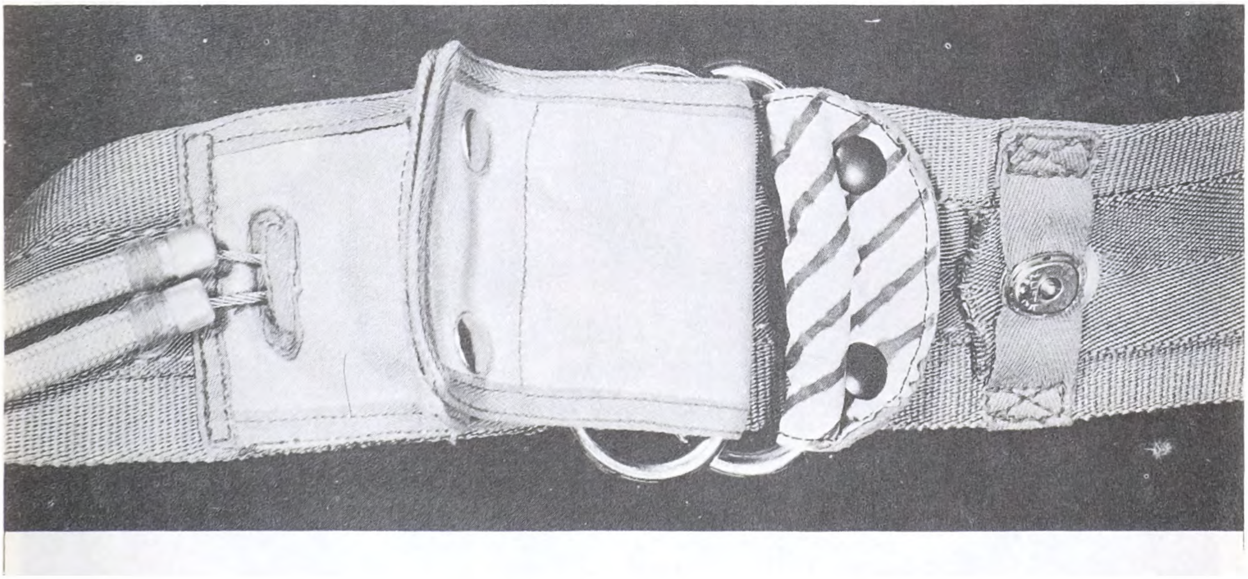


Figure 8-40.—Striped flap replaced.

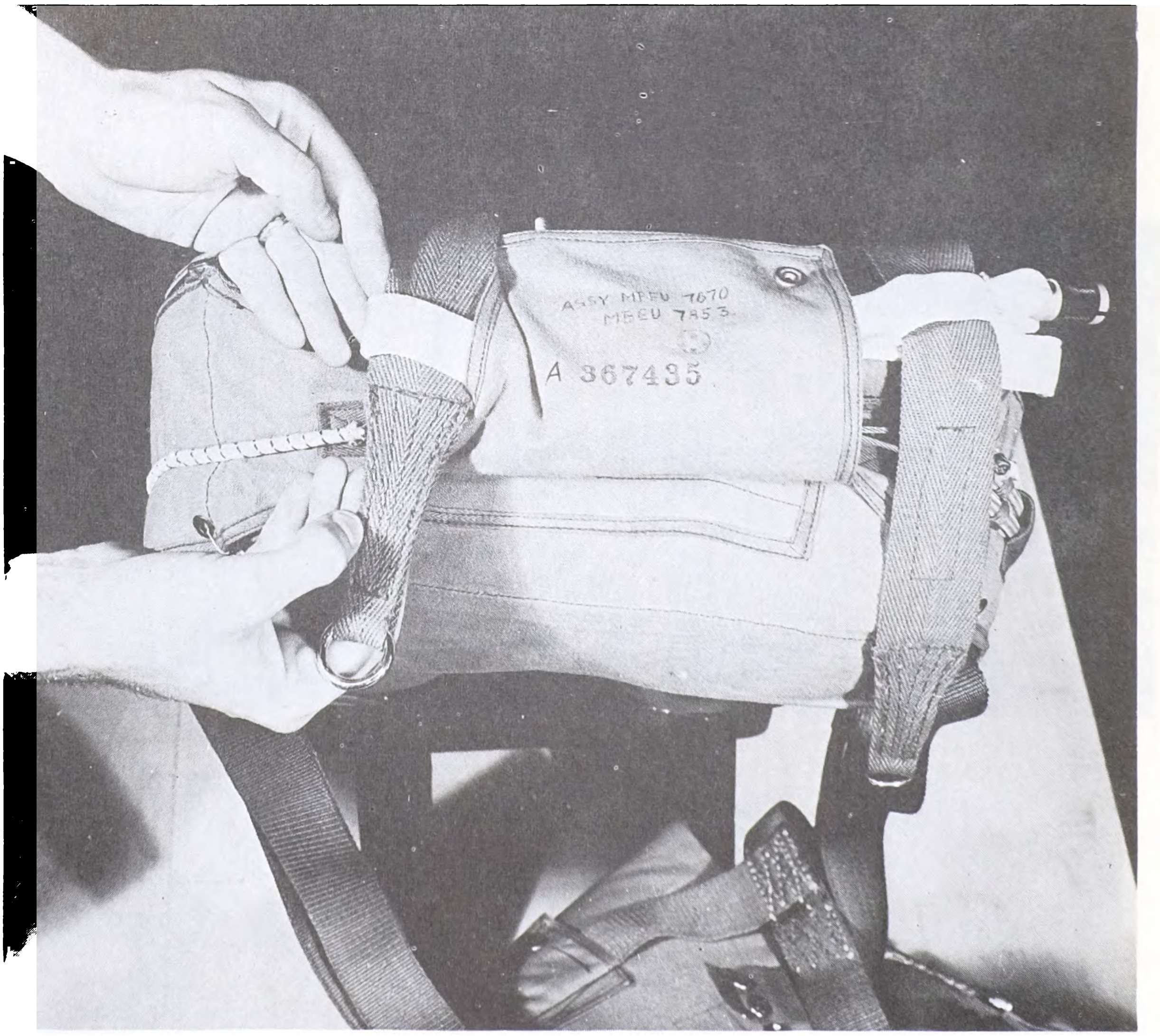


Figure 8-41.—Closing top outer flap.

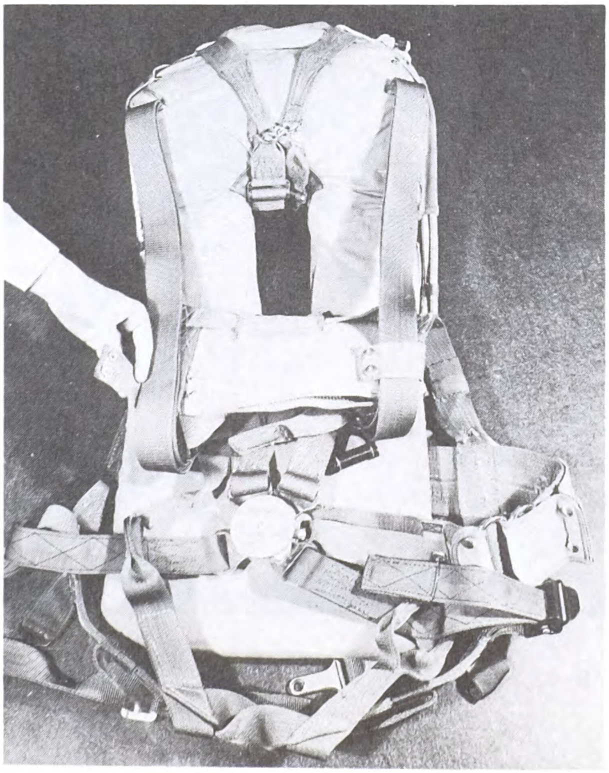


Figure 8-42.—Securing restraint straps.

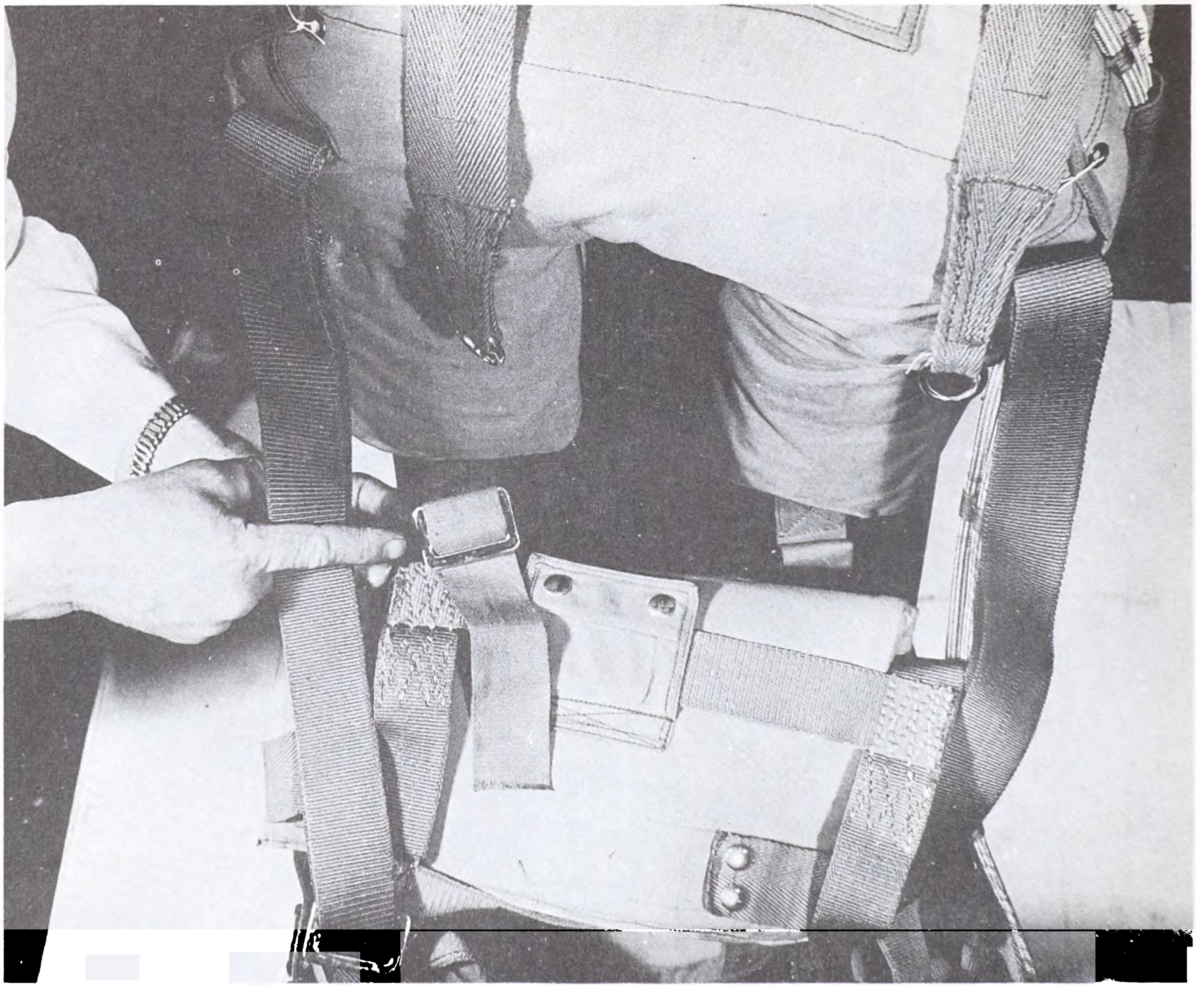


Figure 8-43.- Straps secured between case and harness.

QUIZ

1. The sizes of the drogue chutes used with the Martin-Baker seat are
    a. 22 inches and 5 feet
    b. 5 feet and 9 feet
    c. 9 feet and 12 feet
    d. 24 feet and 26 feet

2. Drogue chutes normally are repacked every
    a. 30 days
    d. 60 days
    c. 90 hours of flight time
    d. 120 hours of flight time

3. The service life of the face blind after installation is
    a. 1 year
    b. 2 years
    c. 3 years
    d. 4 years

4. The size of the personnel parachute used with the Martin-Baker seat is ___ feet.
    a. 22
    b. 24
    c. 26
    d. 28

5. If normal ejection cannot be accomplished by pulling the face blind handle, the pilot should
   a. try to land
   b. dive out of the cockpit and pull the ripcord
   c. invert, fall away from the aircraft, and wait for the parachute actuator to open the parachute
   d. pull the secondary firing handle

6. Ejection at ground level can be made with the Martin-Baker assembly if the
   a. airspeed is over 100 knots
   b. airspeed is over 75 knots
   c. airspeed is under 100 knots
   d. aircraft is in motion

7. During ejection, the seat is fired by
   a. 1 cartridge
   b. 2 cartridges
   c. 3 cartridges
   d. a rocket projectile

8. The purpose of the drogue parachutes is to
   a. lower the pilot safely
   b. get the seat clear of the aircraft
   c. reduce ejection velocity of the seat
   d. stabilize and decelerate the seat

9. The drogue parachutes are stowed in a container
   a. in the headrest
   b. with the main canopy
   c. in the back of the seat
   d. in the front of the seat

10. The controller drogue is packed
    a. on top of the main canopy
    b. in a separate compartment
    c. on top of the stabilizer drogue
    d. beneath the stabilizer drogue

11. Drogue parachutes
    a. must be packed in the loft
    b. must be packed indoors
    c. may be packed on the aircraft
    d. must be removed from the aircraft to pack

12. The expiration date of the face blind is recorded
    a. on the Parachute Record Card
    b. on the Parachute History Card
    c. in the aircraft logbook
    d. in the loft files

13. The controller drogue withdrawal line is connected to the drogue gun by
    a. 2 rivets
    b. 2 screws
    c. a nut and bolt
    d. a male-female fitting and a cotter key

14. When packing the stabilizer drogue, the skirt is folded into
    a. 2 double folds
    b. 3 double folds
    c. 4 double folds
    d. 6 single folds

15. When packing the controller drogue, the withdrawal line is folded into ___folds.
    a. 3
    b. 4
    c. 6
    d. 10

16. The flaps over the drogue parachutes are secured in the following manner
    a. left, right, rear, front
    b. right, left, rear, front
    c. right, left, front, rear
    d. left, right, front, rear

17. When the personnel parachute is laid out for packing, panel ___ is up.
    a. 1
    b. 13
    c. 24
    d. 28

18. When folding the personnel parachute canopy, each group of 12 panels is folded in a double fold, dividing the group into ___parts.
    a. 2
    b. 3
    c. 4
    d. 6

19. When folding the canopy on the 24-foot parachute, the folds end ___feet from the apex.
    a. 4
    b. 5
    c. 6
    d. 7

20. The links on the personnel parachute are tacked with
    a. 3 cord
    b. 6 cord
    c. 9 cord
    d. E thread

21. Before the 2 groups of lines are stowed together, when packing the personnel parachute, each group is stowed separately in ___ hesitator loops.
    a. 4
    b. 5
    c. 6
    d. 13

22. When the canopy is stowed in the container of the Martin-Baker parachute, the apex is to the
    a. left, with the vent lines to the right
    b. right, with the vent lines to the left
    c. left, with the vent lines to the left
    d. right, with the vent lines to the right

23. The personnel parachute container should be closed over the canopy in the following manner
    a. back flap, front flap, inner back flap
    b. front flap, back flap, inner back flap
    c. inner back flap, front flap, back flap
    d. inner back flap, back flap, front flap

24. The slide fasteners are secured to the grommets with
    a. A thread, nylon
    b. B thread, nylon
    c. F thread, nylon
    d. 16 x 4, cotton

25. The slide disconnect is safe-tied with
    a. A thread, nylon
    b. B thread, nylon
    c. E thread, nylon
    d. 16 x 4, cotton

CHAPTER 9

PACKING AND RIGGING THE RAPEC PARACHUTE

Rapec Ejection System

The A4D RAPEC (Rocket Assisted Personnel Ejection Catapult) escape system is a newly developed escape system currently being installed in A4D series aircraft. This escape system, like the Martin-Baker (described in Chapter 8), provides safe ejection throughout the speed and altitude envelope of the A4D aircraft.

The A4D RAPEC escape system is designed to eject the pilot and seat from the aircraft by means of the RAPEC I rocket catapult. Emergency escape is accomplished by pulling a face curtain located above the pilot's head, or by pulling a D-ring located between the pilot's legs. Actuation of either of these release mechanisms will jettison the canopy, position the inertia reel, and fire the RAPEC I rocket catapult which ejects the seat.

As the seat is ejected up the ejection rails, the harness release actuator is armed. Three-fourths of a second after arming, the harness release actuator fires and releases the pilot from the seat. At the same time, bladders on the seat back and bucket inflate and provide positive seat separation.

Upon seat separation, the displacement of man from seat pulls the arming lanyard to activate the automatic parachute actuator. If above 10,000 feet, the pilot will free fall to 10,000 feet before deployment of the parachute. The aneroid unit within the automatic actuator prevents actuation above 10,000. If below 10,000 feet upon seat separation, the automatic actuator fires the 2-second time delay cartridge. (The operation of automatic parachute actuators is explained in chapter 10.)

The parachute designed for use with this system is a back type assembly, designated the NB-9. The packing and rigging instructions contained in this chapter are applicable to the NB-9 for installation in the A4D series aircraft.

NB-9 Parachute

The NB-9 parachute is an integrated back type assembly designed for use with the A4D RAPEC escape system. It is configured especially for use in the A4D series airplane to replace the NB-5 parachute upon incorporation of A4D Aircraft Service Change No. 157, the rocket catapult ejection seat.

DESCRIPTION

The NB-9 parachute assembly consists of a semirigid contoured pack, 28-foot flat circular canopy, PA-7 pilot chute, integrated riser/shoulder and lap belt assembly used with a seat pan, and a PK-2 parachute kit in high-speed container.

The NB-9 assembly is designed to be equipped with a Master Specialties 1000-D barometrically controlled automatic parachute actuator incorporating a BuWeps Mk V Mod 0, 2-second delay cartridge. Provisions have also been made to permit optional installation of the Irvin Mk V actuator. If the necessity arises wherein it is necessary to utilize the Irvin Mk V actuator, it should be tested to determine the time delay prior to its installation, in accordance with NavAer 13-15-504. If the time delay is not 2 seconds, it should be returned to Supply for shipment to the cognizant Overhaul and Repair activity for correction of time-delay setting. ONLY A 2-SECOND TIME DELAY IS PERMISSIBLE IN THE AUTOMATIC ACTUATOR. It should be noted that an altitude setting inspection port has been incorporated on the cushioned surface of the pack.

The NB-9 parachute assembly has a semirigid contoured pack designed to provide improved comfort and compatibility with the A4D cockpit. Conventional type closing flaps, attached to a fiberglas frame, together with an integral comfort pad, comprise the basic portion of the pack. The semiclosed corners of the pack provide improved windblast integrity. Improved comfort, as well as appearance, is achieved by routing the pack opening bands through webbing tunnels on the inside of the pack and the elimination of external snaps, buttons, etc., on the forward surface of the pack.

To assure optimum compatibility of the NB-9 parachute and rocket ejection seat, it is essential that the parachute be packed as flat as possible. A relatively flat pack is necessary to (1) maintain adequate knee clearance during ejection, (2) provide good compatibility with headrest for scanning of instruments during catapult launching, and (3) to minimize rocking of the parachute against the seat back. A check template should be utilized (as described later) to insure that the parachute pack has been packed relatively flat.

The NB-9 assembly incorporates the PA-7 vane type pilot chute incorporating 8 vanes and a substantially stronger helical spring than the PA-8. The PA-7 pilot chute is attached to the canopy with a bridle that measures 36 inches net length.

INSPECTION

The parachute should be inspected periodically as outlined in chapter 3. Complete disassembly, inspection, and packing instructions are outlined on the following pages.

Disassembly Procedure

1. Detach the parachute pack from the seat pan by threading type VIII nylon webbing straps out of AN6565-1 adapters located on the sides of the PK-2 seat pan assembly.

2. Cut hand tacking from the slider and open the zipper attaching the parachute container to the PK-2 seat pan assembly.

3. Open the pack by pulling the manual ripcord. UNDER NO CONDITIONS should PACKS EQUIPPED WITH MASTER SPECIALITIES ACTUATOR BE OPENED IN THE PARACHUTE LOFT BY REMOVAL OF THE ARMING CABLE. This includes all models (1000A, B, C, and D.) Such action would actuate the Mk V Mod 0 cartridge, thus requiring disassembly, cleaning of the barrel assembly, and relock-wiring of the piston assembly. Remove the canopy and lines from the pack.

4. Unzip the actuator pocket and remove the actuator for visual inspection. Inspect per ACSEB No. 14-60 and insure that the actuator is a Model 1000-D. In addition, inspect for the following:

Damage to cover, piston socket, arming housing and cable, power housing, and cable including terminal eye in the end of the power cable.

Security of cover screw.

Lock-wiring of piston socket. This can be accomplished by shining a flashlight down the open end of the cover.

5. In the event an Irvin Mk V actuator is installed in the NB-9, the pack may be opened by pulling the arming wire. Pack opening time should be taken with a stopwatch. If the pack fails to open within 2 ± 1/2 seconds, the release must be removed, a new one installed, and the old one returned to Supply for shipment to the cognizant Overhaul and Repair activity for calibration.

Inspection Procedure

1. Unsnap the riser/shoulder harness assemblies from the pack, put the pack aside, and lay the canopy full length on the packing table. Anchor the links through a spreader bar and the canopy apex at the opposite end of the table.

2. Check suspension line continuity in accordance with NavAer 13-5-501.

3. Inspect riser/shoulder harness assembly and lap belt assembly for frayed webbing, worn spots, broken stitching, or other signs of deterioration. Inspect the shoulder strap and lap belt end fittings for burrs or deformed locking pin holes in the lap belt fittings. The nylon roller in the shoulder strap end fitting should rotate freely.

4. Inspect the four canopy and lap belt connectors for damage, corrosion, or foreign matter, such as sand or dirt. If necessary, remove foreign material from connectors, using shop compressed air. Check the fittings for proper operation and locking by opening and closing. There should be no binding and the release mechanism must operate readily.

5. Inspect the pull-the-dot snaps on the risers to assure that they mate properly with studs on the pack.

6. Inspect the automatic actuator pocket for tears, worn spots, broken stitching, and operation of slide fasteners and snaps.

7. Inspect the pack assembly for holes, tears, worn spots, damaged grommets and cones, and for condition of snaps, line retaining loops, pack opening bands, and security of eyes.

8. Check the security of the ripcord housing clamp on the pack top flap and of the manual ripcord and actuator power housings.

9. Inspect the attachment of manual ripcord housing to the left-hand riser assembly and also the condition of the ripcord retainer clip.

10. Inspect the manual ripcord for frayed cable or bent and burred pins. If the cable is frayed or corroded, the entire ripcord assembly should be replaced. Burred pins should be carefully smoothed with fine emery paper.

11. Inspect canopy, gore-by-gore, for tears, dirty or stained spots, broken stitching, or other signs of damage or deterioration.

12. The pilot chute should be inspected for damage or broken spring, damaged cone, tears, dirty spots or stains, or other signs of damage or deterioration. The pilot chute bridle should be checked for wear damage. Pilot chute bridle should measure 36 ± 1/2 inches from suspension lines at the vent of 28-foot canopy to the pilot tie-off loop.

PACKING INSTRUCTIONS

1. Lay out the canopy in the conventional manner with the retaining groove in the canopy connector fitting face down on the table, as shown in figure 9-1. The parachute canopy is then pleated and folded in accordance with NavAer 13-5-501, *Parachute Manual*, except that the skirt edges are folded to meet at the center of the two top gores, as shown in figure 9-2.

2. Set the automatic actuator in accordance with the installation and maintenance instructions, install in pocket, and route arming and power housings as shown in figures 9-3 and 9-4. CAUTION: THE MASTER SPECIALITIES ACTUATOR MUST BE LOADED WITH ONLY A MK V MOD O, 2-SECOND DELAY CARTRIDGE (BLUE COLOR CODED).

3. If necessary to install an Irvin Mk V actuator, insert it in the pocket as shown in figure 9-5, making certain that the lug is inserted through the slot between the pocket wall and the bottom webbing. Route the arming and power housings as shown in figures 9-5 and 9-6. Figure 9-7 shows the Irvin Mk V actuator completely installed with the pocket snapped to the container false bottom. It should be noted that a mounting plate is not required for installation of the Mk V actuator in the NB-9 parachute. CAUTION: THE IRVIN MK V ACTUATOR MUST BE SET FOR A 2-SECOND TIME DELAY.

4. Slide the pack under the risers with the top of the pack nearest the riser connectors, as shown in figure 9-8.

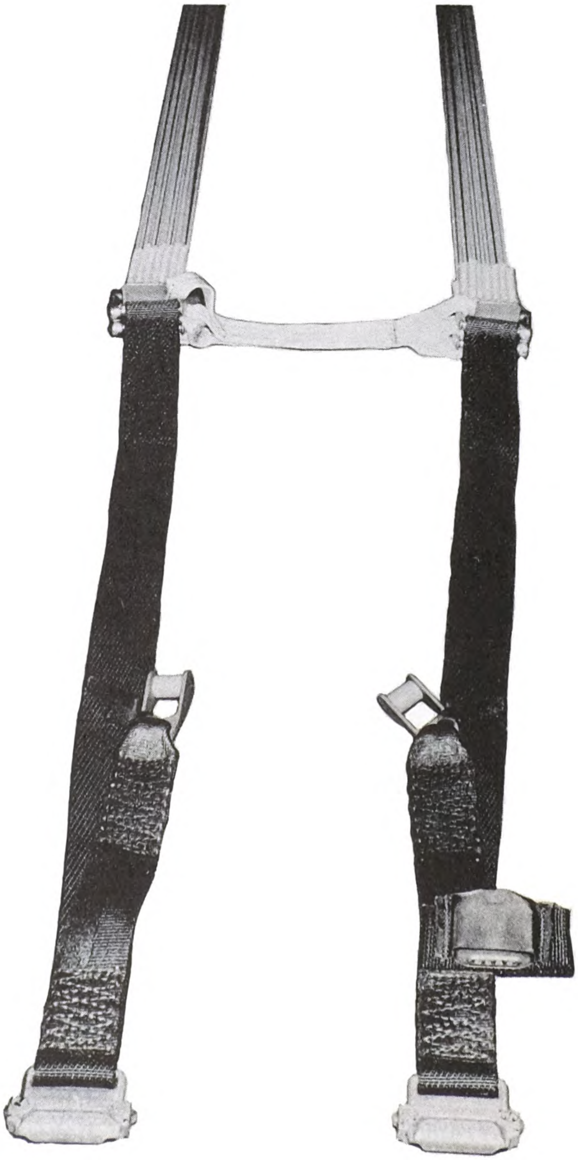


Figure 9-1.—Canopy and harness laid out for inspection.

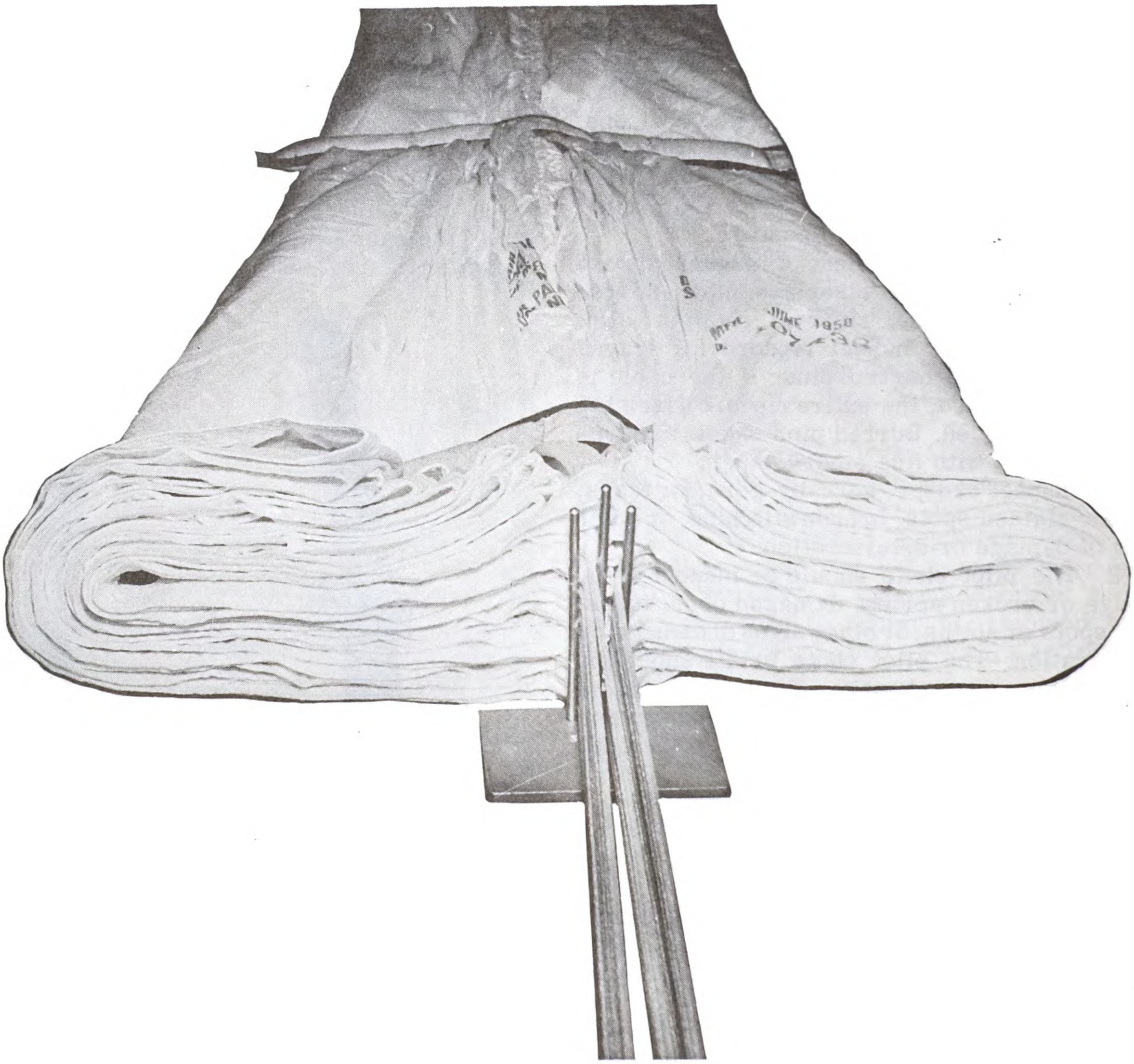


Figure 9-2.—Canopy folded and skirt edges folded and turned to meet center of two top gores.

5. Snap the risers into the bottom set of pull-the-dot studs on the pack false bottom, as shown in figure 9-9.

6. Install and/or check security of the manual ripcord housing and the automatic actuator power housing. (See fig. 9-10.)

7. Arrange the suspension line links and cross-connector straps to lay as flat as possible on the pack false bottom, then draw the suspension lines through the top left-hand retainer loop, as shown in figure 9-11.

8. Complete stowage of the suspension lines in accordance with standard practice and as shown in figure 9-12. The bottom inboard loop on the left-hand side is omitted, as shown in figure 9-13. NOTE: TO FACILITATE SUSPENSION LINE PULL-OUT, STOW LINES SO THAT LINES EXTEND THROUGH LOOPS APPROXIMATELY 1/2 INCH.

9. Place the skirt at the TOP OF THE PACK making certain that the canopy material is spread beyond the outer edges of the pack, as shown in figure 9-14.

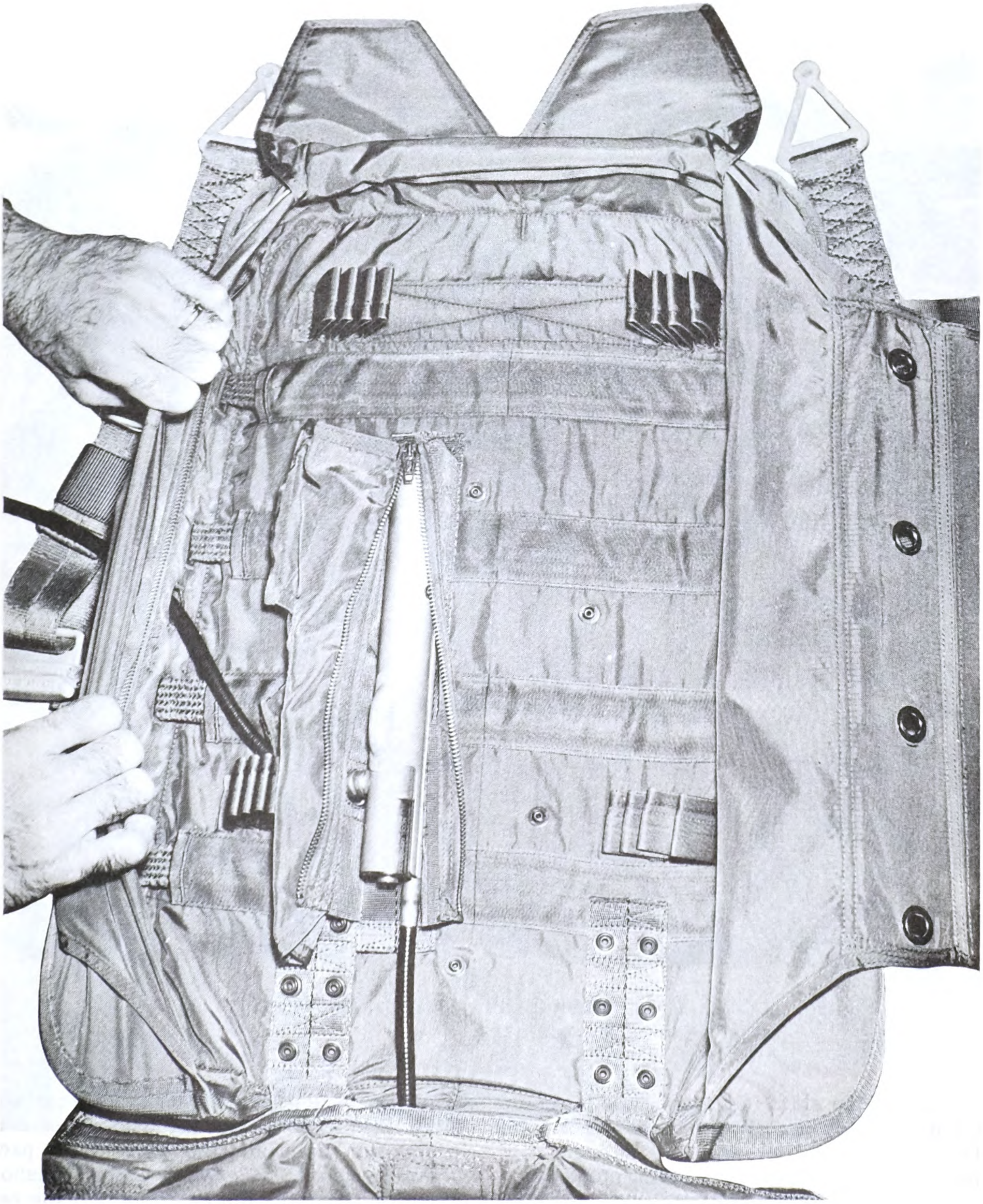


Figure 9-3 —Mk V Mod 0 being installed in pocket.

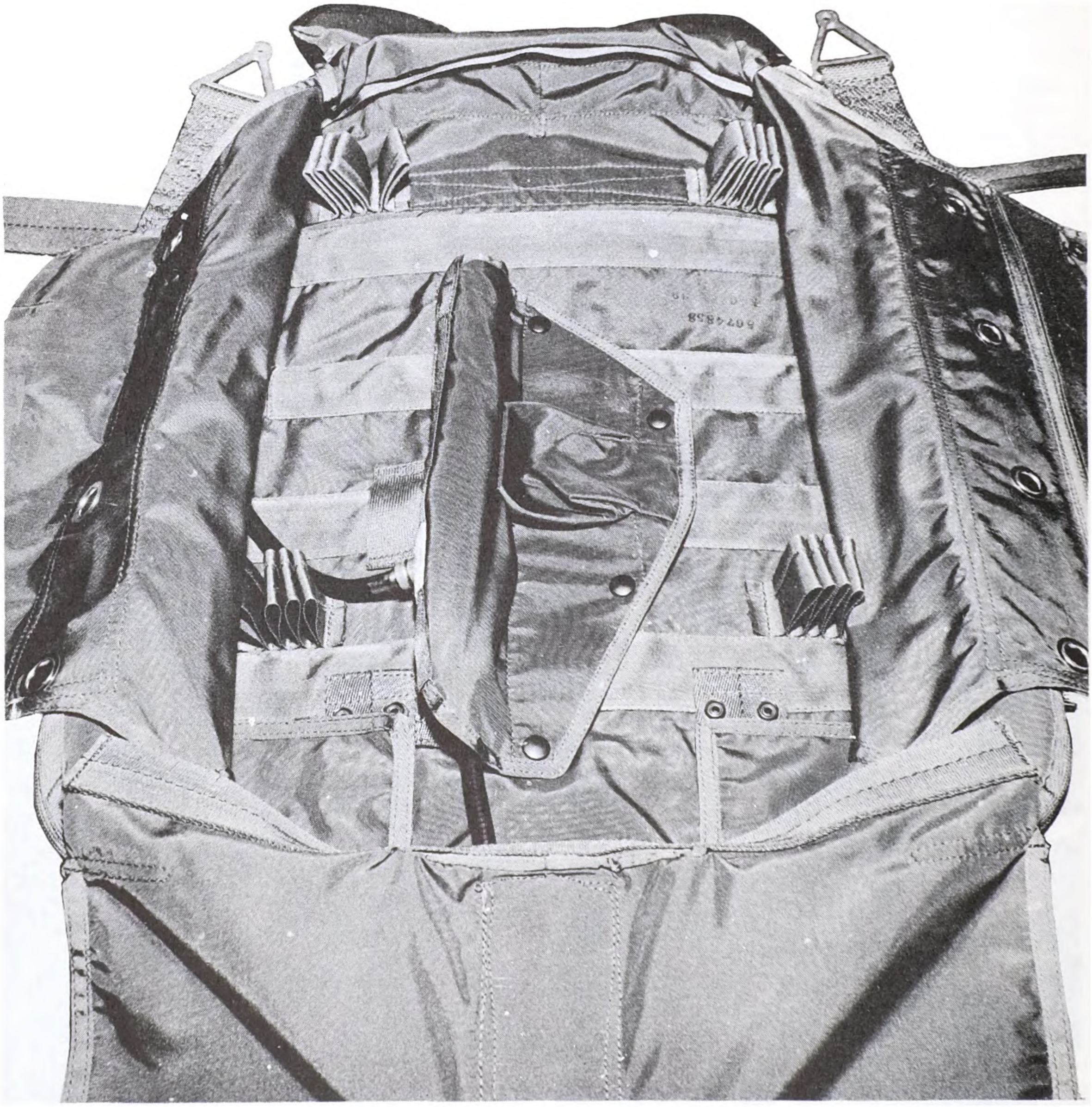


Figure 9-4.—Mk V Mod 0 installed in pocket and housing passed through side of pack container.

10. Insert the skirt into the top portion of the pack butting lines against the center section of the frame, spreading the edges into the corners of the pack. Complete accordion folding of the canopy in accordance with standard practice except that two complete folds are brought to the bottom of the pack, as shown in figure 9-15. NOTE: When folding the canopy into the pack, spread the material to the corners and make a concerted effort to force as much canopy material as possible in the void between the outboard lay of suspension lines and the edge of the pack, as shown in figure 9-16. Special attention should be given to filling out the top corners of the pack as solidly as possible. If a small amount of care is exercised in proper stowage of the canopy, a flatter pack, which will nest properly when installed in the seat, will result.

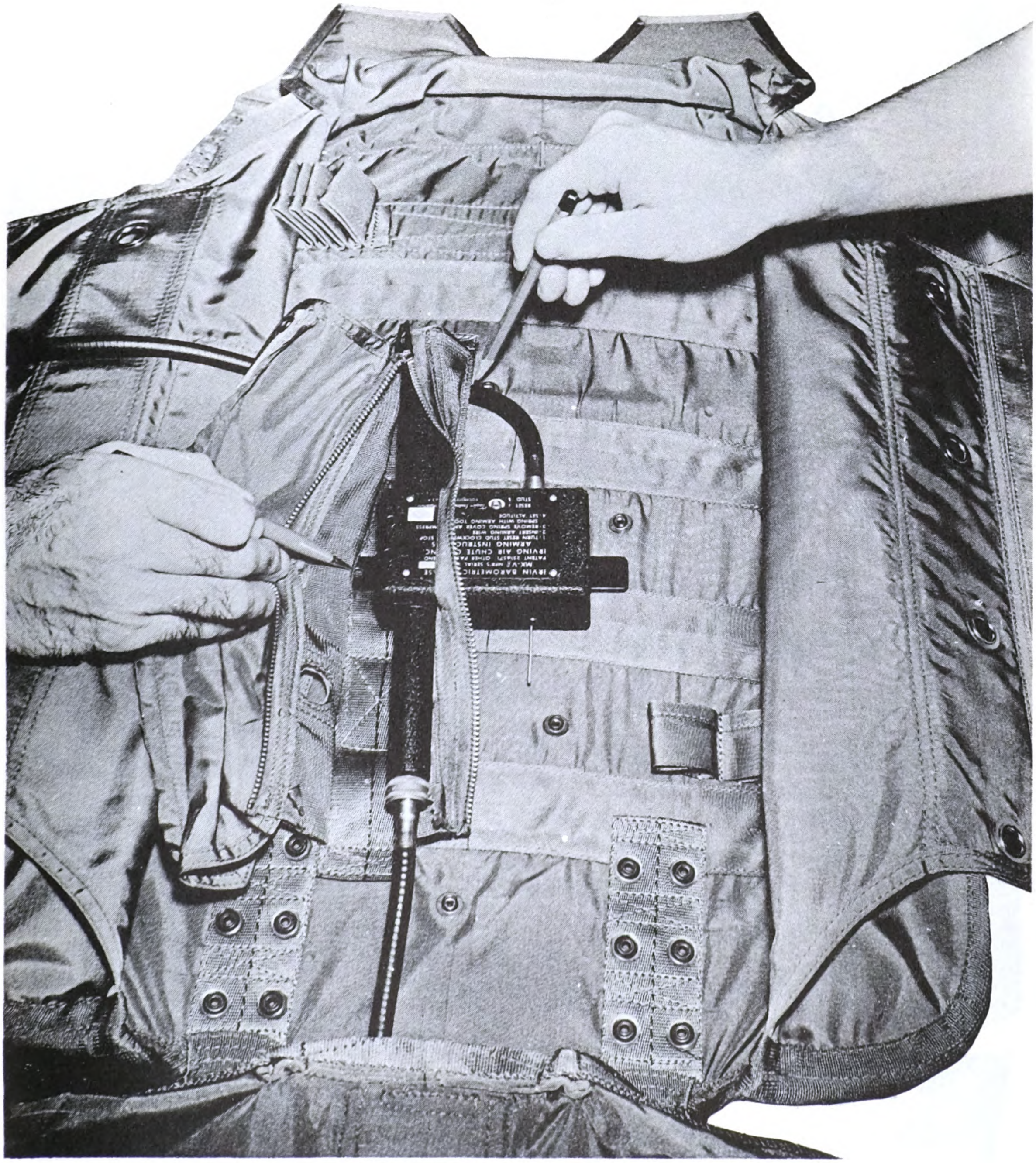


Figure 9-5. --Installation of the Irvin Mk V Automatic Actuator in pack container.

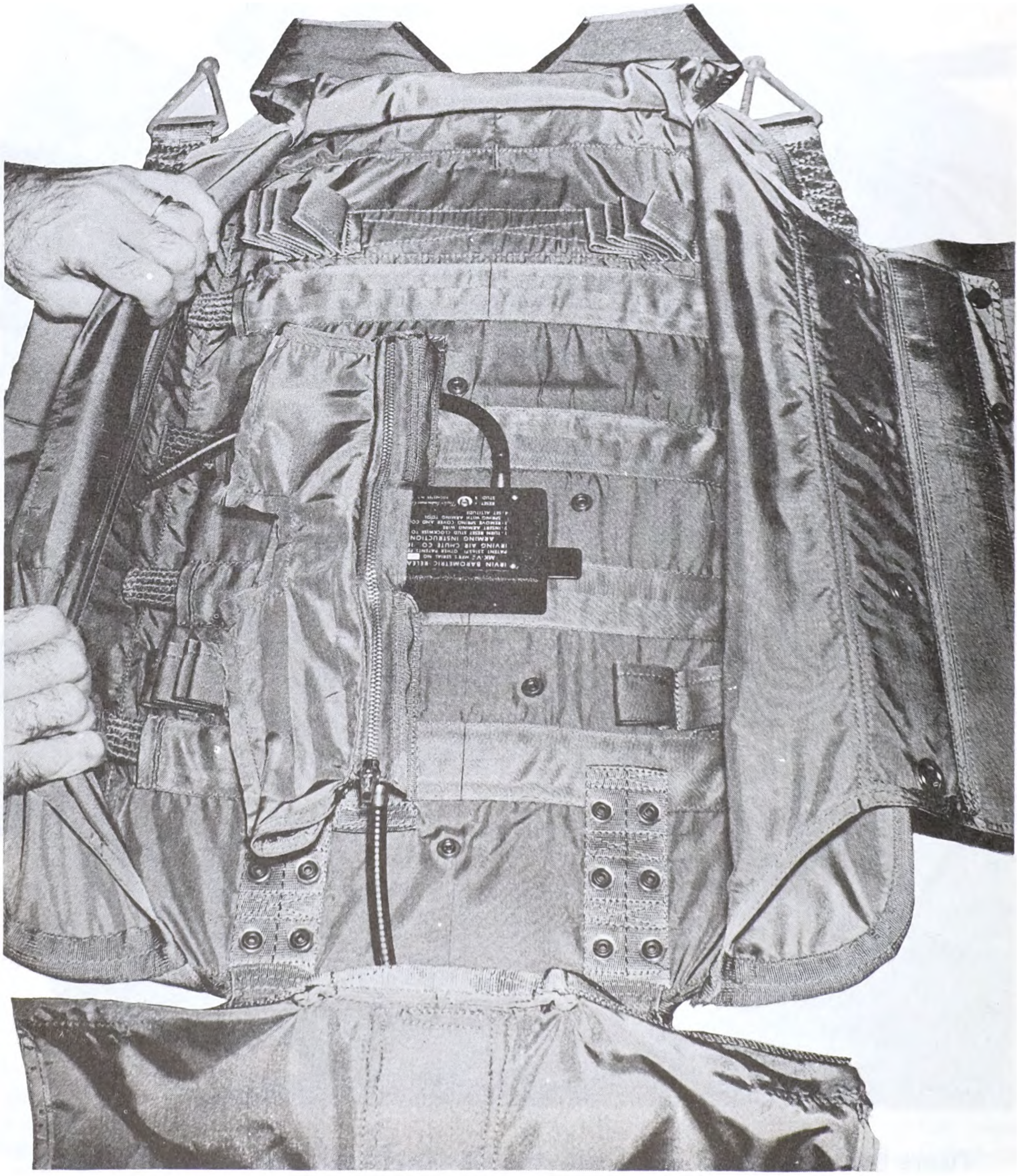


Figure 9-6.—Housing installed through side of pack container.

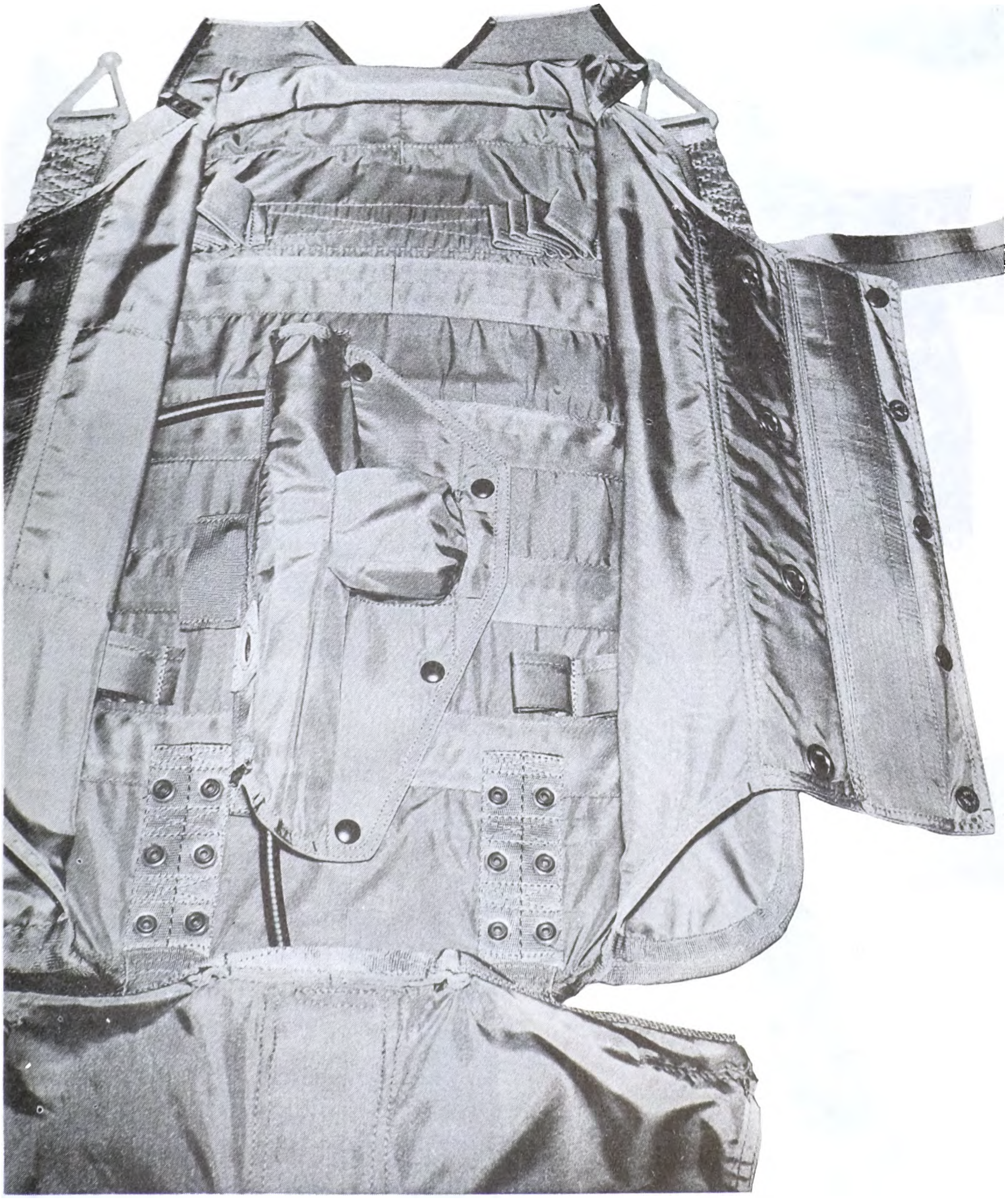


Figure 9-7. --Irvin Mk V completely installed with pocket snapped to container false bottom.

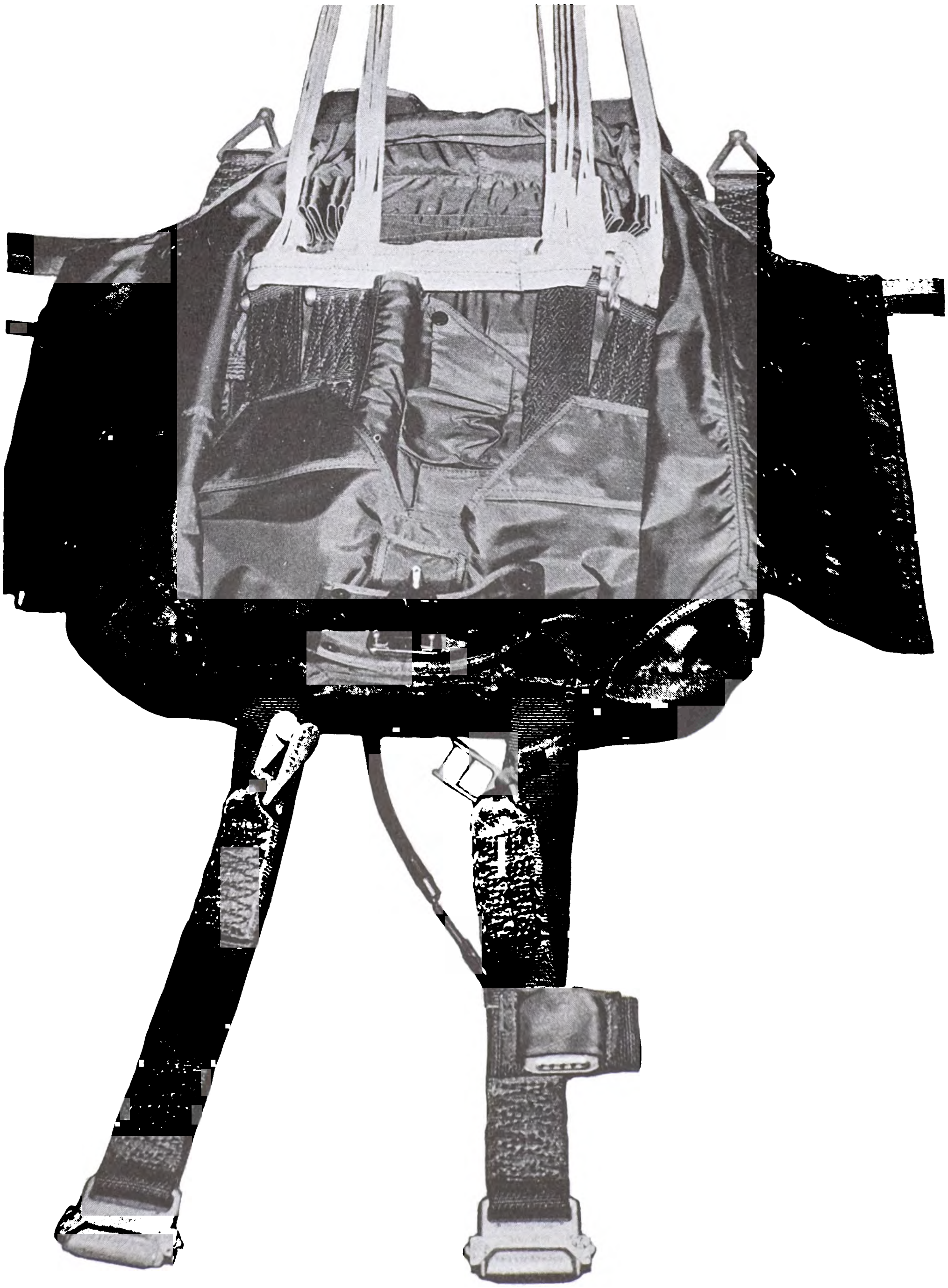


Figure 9-8. --Pack container slid under risers.

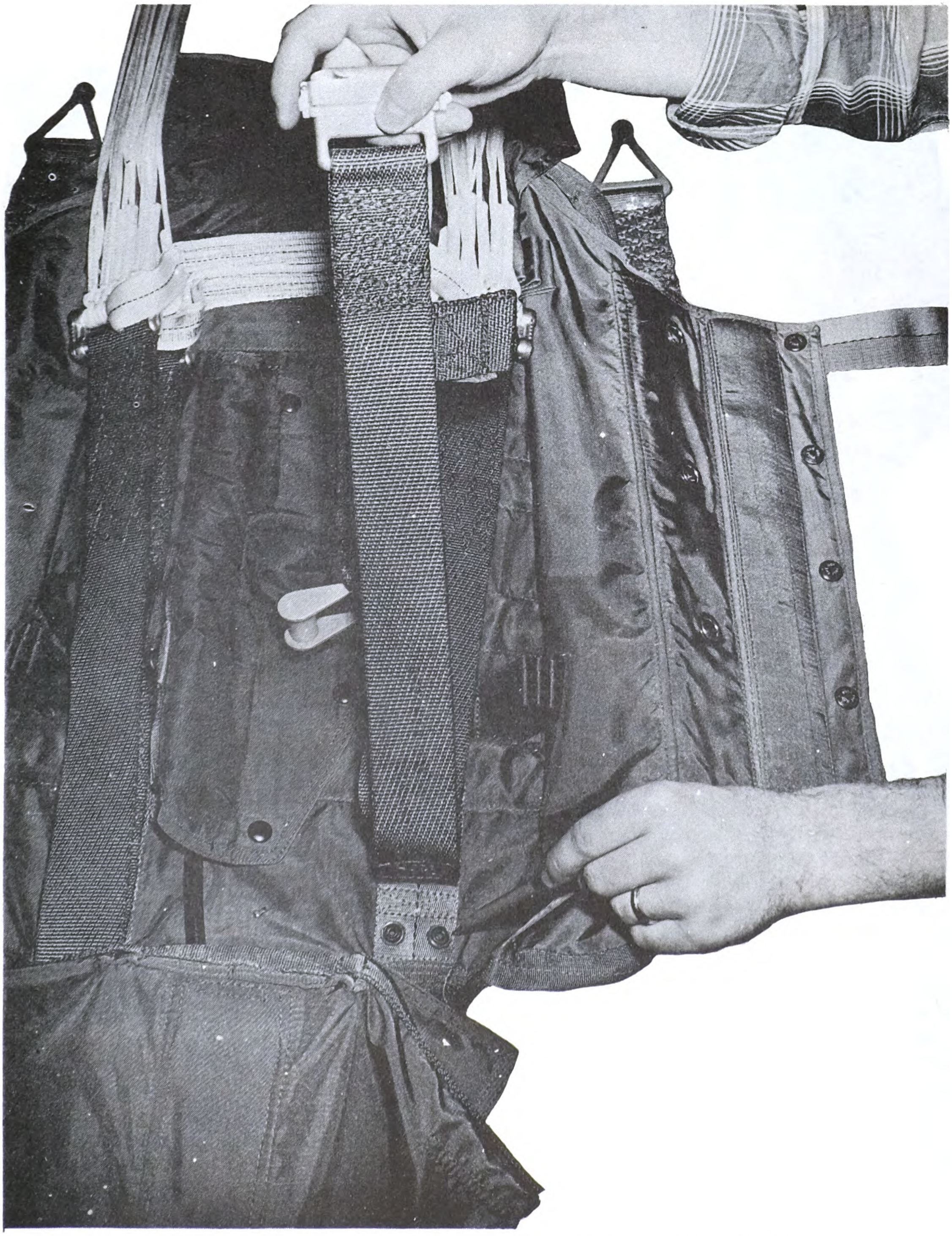


Figure 9-9. --Snap risers into bottom set of pull-the-dot studs.

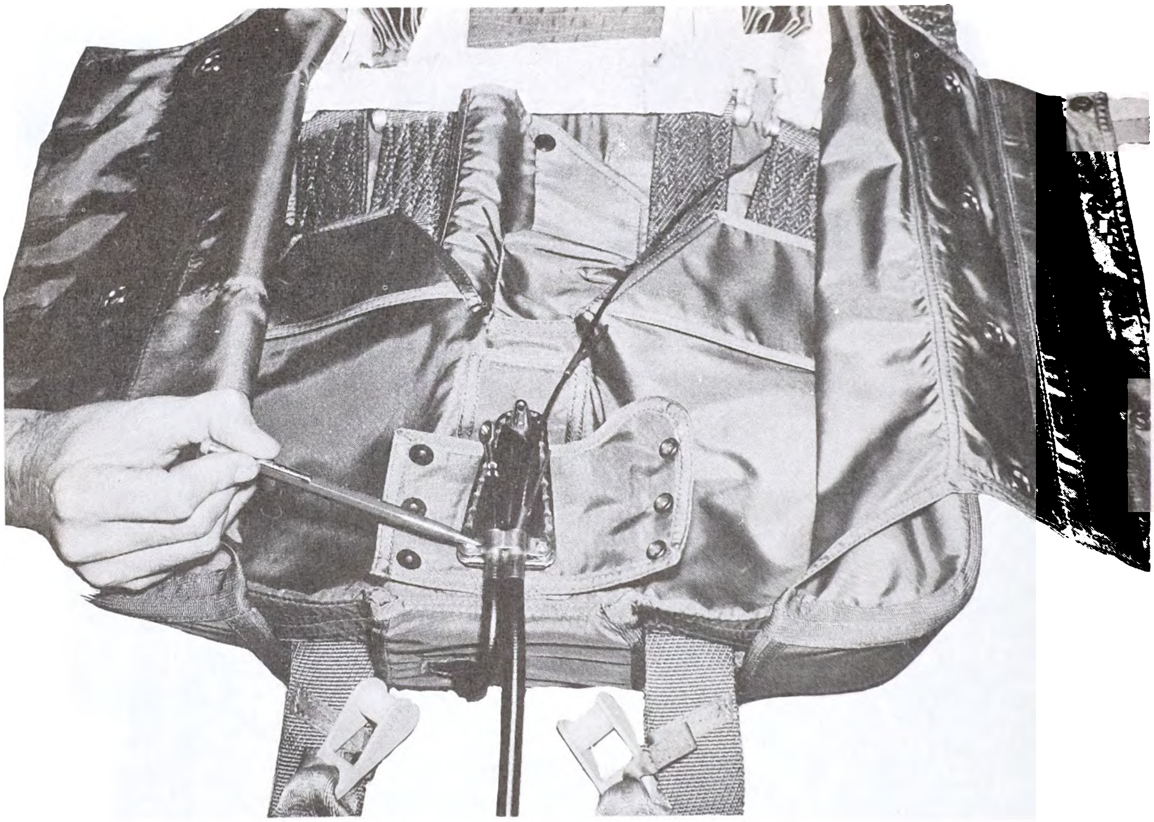


Figure 9-10. --Install and/or check security of manual ripcord housing.

11. Prepare the pilot chute for installation by compressing the pilot chute, utilizing a guide tube to align the cone with the grommet, as shown in figure 9-17. Insert the temporary locking pin in the bottom hole of the cone. (See figure 9-18.) Pull the nylon material away from the cone until no material shows through the grommet.

12. Position the pilot chute on top of the folded canopy with the pilot chute cone in line with the second grommet from the top of the pack side flaps. Figure 9-19 shows the pilot chute in the installed position with the bottom flap tucked in and one side flap closed. The temporary locking pin is not normally installed in this step and is shown only to further clarify proper positioning of the pilot chute.

13. Pull up the other side flap and position the grommets over the pilot chute cone. Remove the temporary locking pin plate and insert a temporary locking pin as shown in figure 9-20.

14. Close the top flap, using a packing bar to insert the end tabs. Wrinkles or folds in the top or bottom flaps should be removed by using a fid or packing bar.

15. Insert the top ripcord locking pin in the automatic actuator power cable terminal eye, as shown in figure 9-21.

16. Remove the temporary locking pin, insert the ripcord pins, and safety-tie the bottom ripcord pin with size A nylon thread, as shown in figure 9-22.

17. Hook up the pack opening bands, close the ripcord cable protector flap and secure the dual housing clamp cover. The edge of this cover should be placed over the ripcord protector flap, as shown in figure 9-23.

18. Insert the ripcord housing retainer clip, as shown in figure 9-24. Safety-tie the clip through both plies of the webbing and through the hole in the clip with size A nylon thread.

19. Install the ripcord grip in the retainer clip, as shown in figure 9-25. The Parachute Record Card pocket is also shown in figure 9-25.

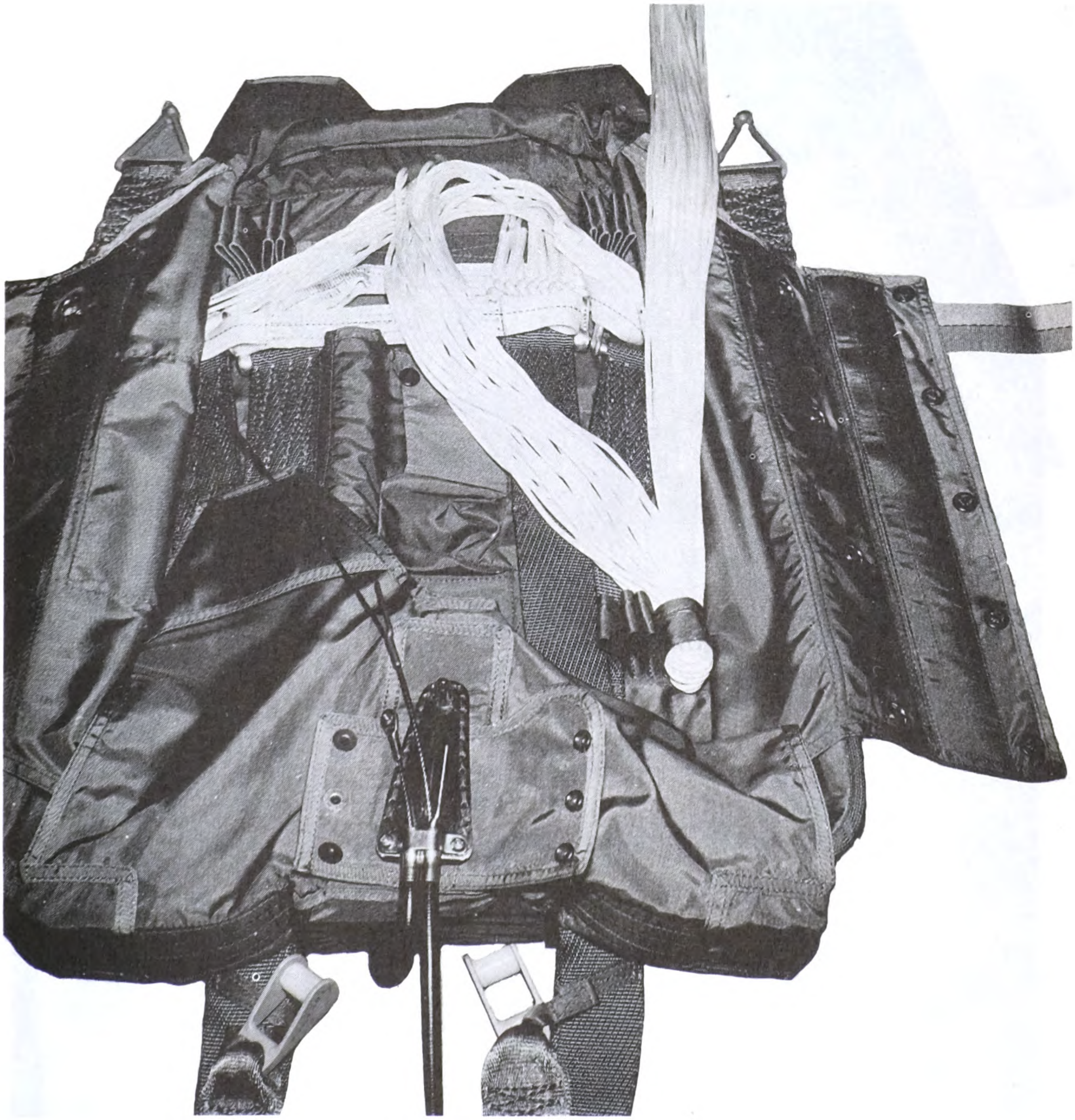


Figure 9-11. --First bight stowed through the left-hand retainer loop.

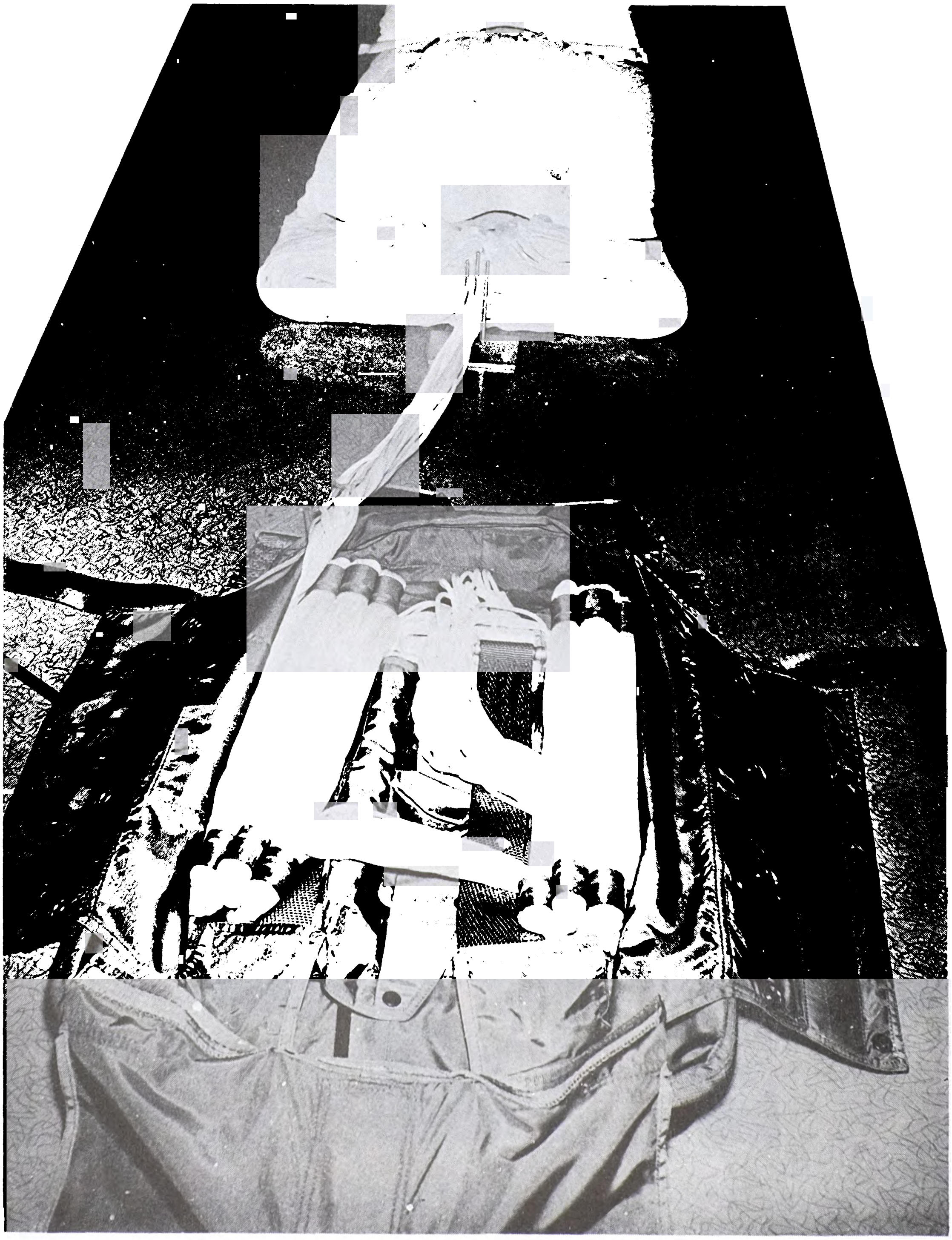


Figure 9-12. --Stowage of suspension lines completed.

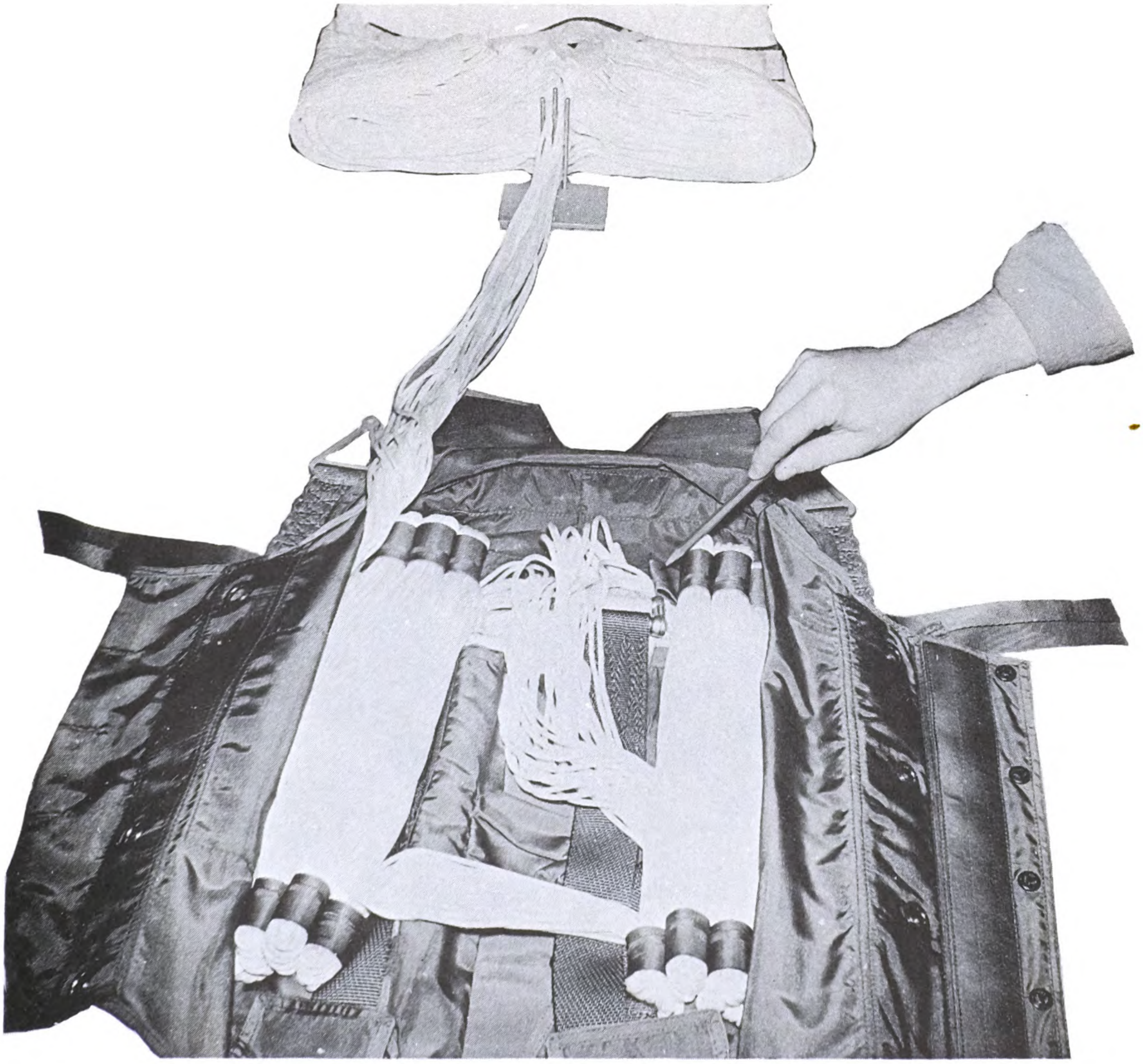


Figure 9-13. --Bottom inboard loop on left-hand side is omitted.

20. Use a check template for checking the flatness of the parachute pack, as shown in figures 9-28 and 9-29.

Reassembly of Pararaft Kit and Seat Pan

Connect the slide fastener on the Parachute Record Card pocket flap to the mating slide fastener on the pararaft container, and safety-tie the slider with two turns of nylon 6-cord, MIL-T-7807. (See fig. 9-26.) Thread type VIII nylon webbing straps at the bottom of the parachute through AN6565-1 adapters, located on both sides of the pararaft/seat pan assembly (fig. 9-27), and pull taut. The free end of the webbing should extend beyond the edge of the adapter approximately 1-1/2 ± 1/8 inch. Safety-tie both webbing ends with two turns of 6-cord nylon, MIL-T-7807, as shown in figure 9-27.

Figure 9-14. --Skirt placed at top of the pack.

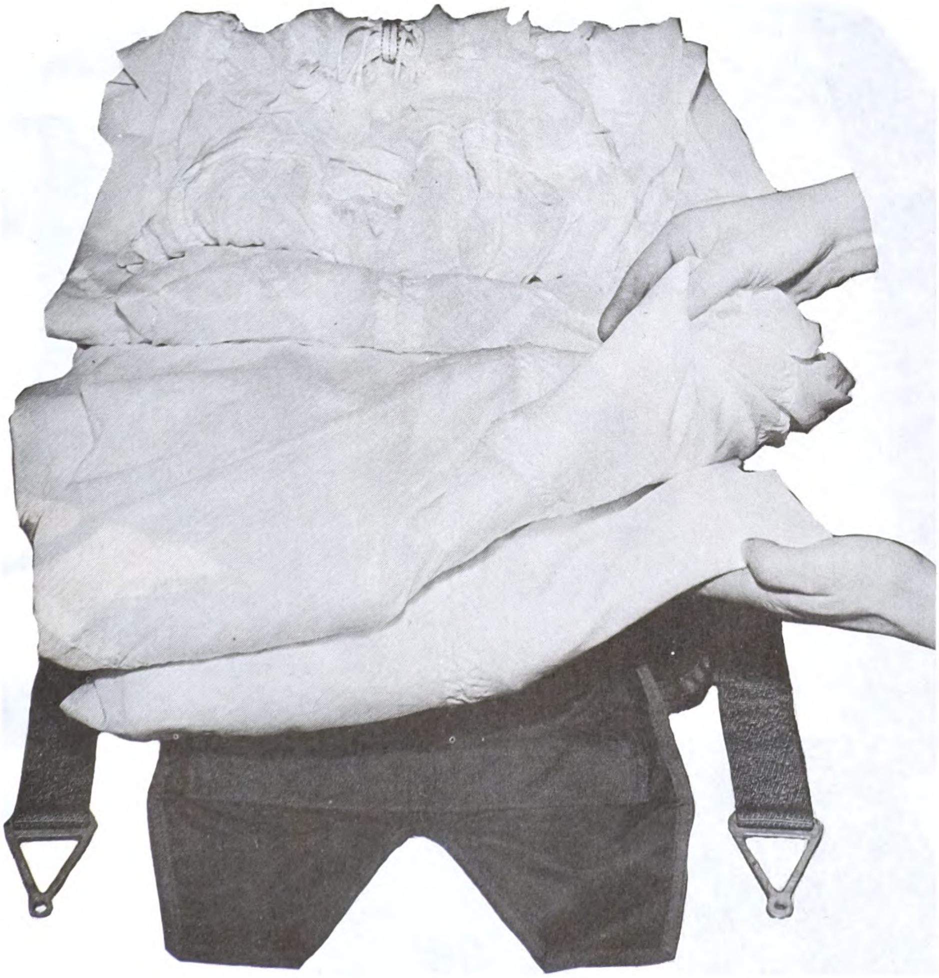


Figure 9-15. --Two complete folds brought to bottom of pack.

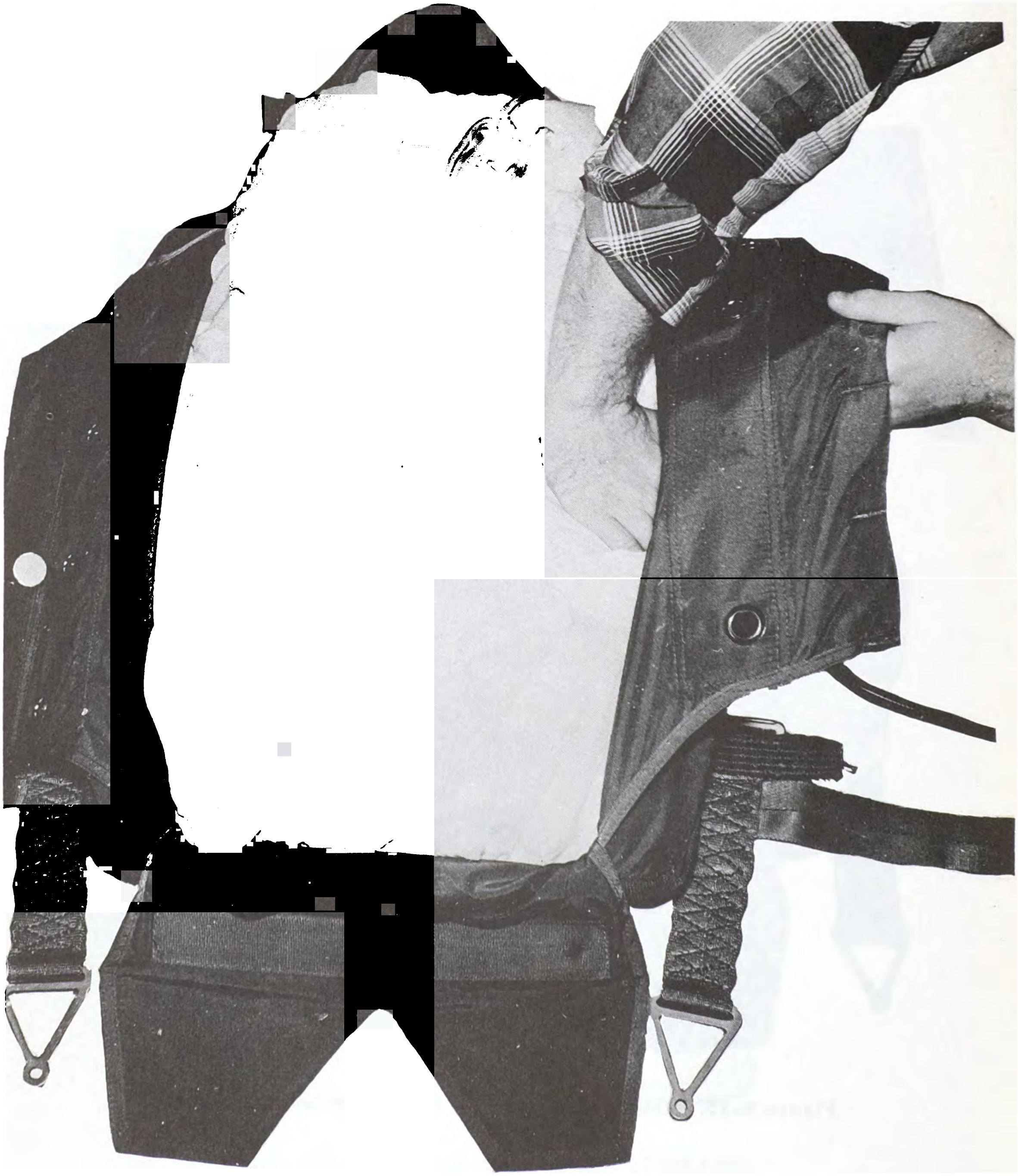


Figure 9-16. --Filling void on outboard sides of pack.

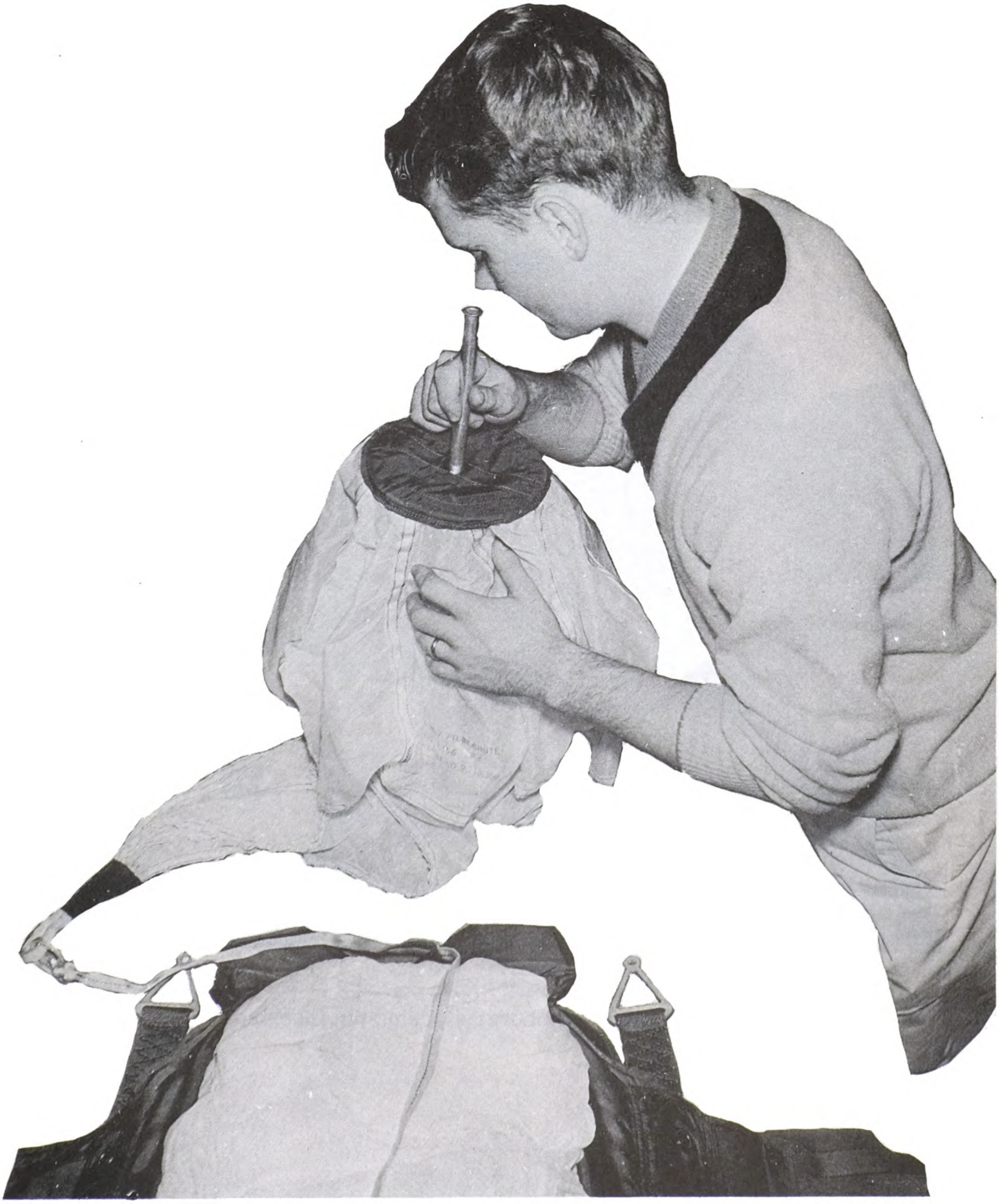


Figure 9-17. --Aligning cone with grommet, using guide tube.

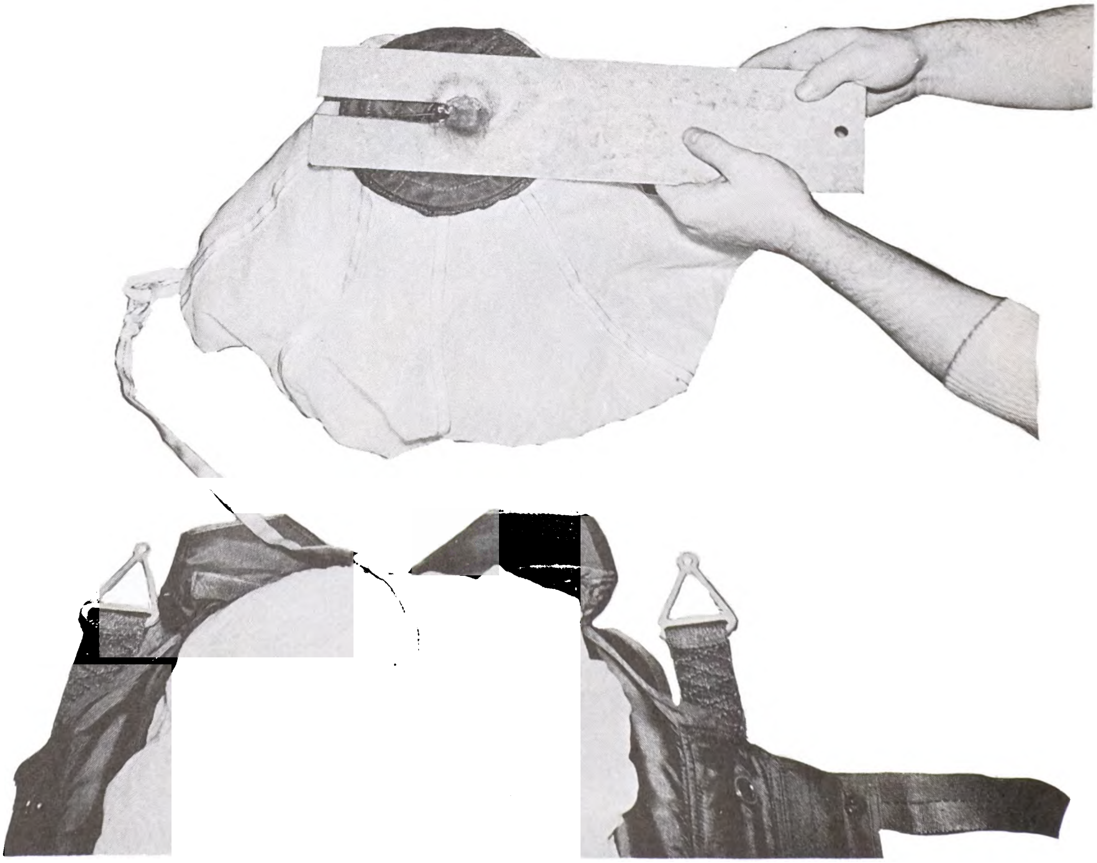


Figure 9-18. --Temporary locking pin inserted.

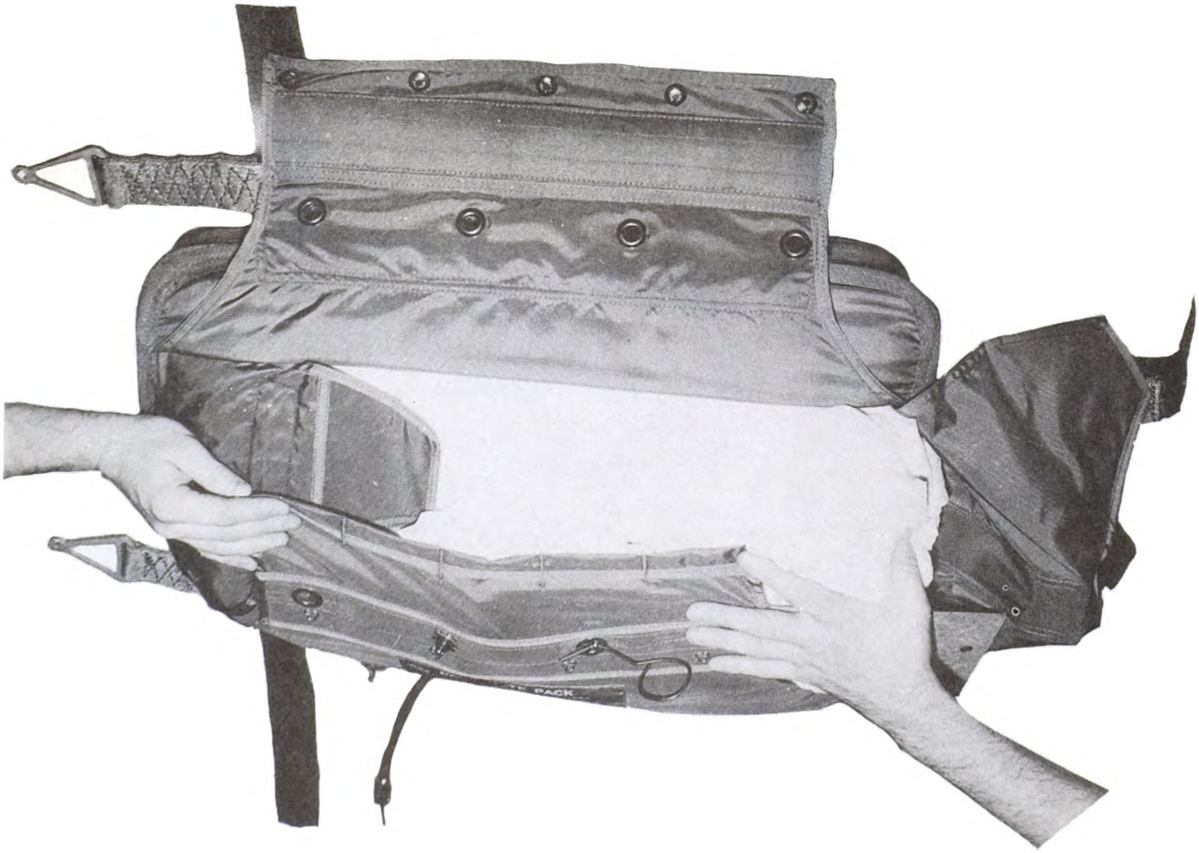


Figure 9-19. —Position pilot chute on top of folded canopy.

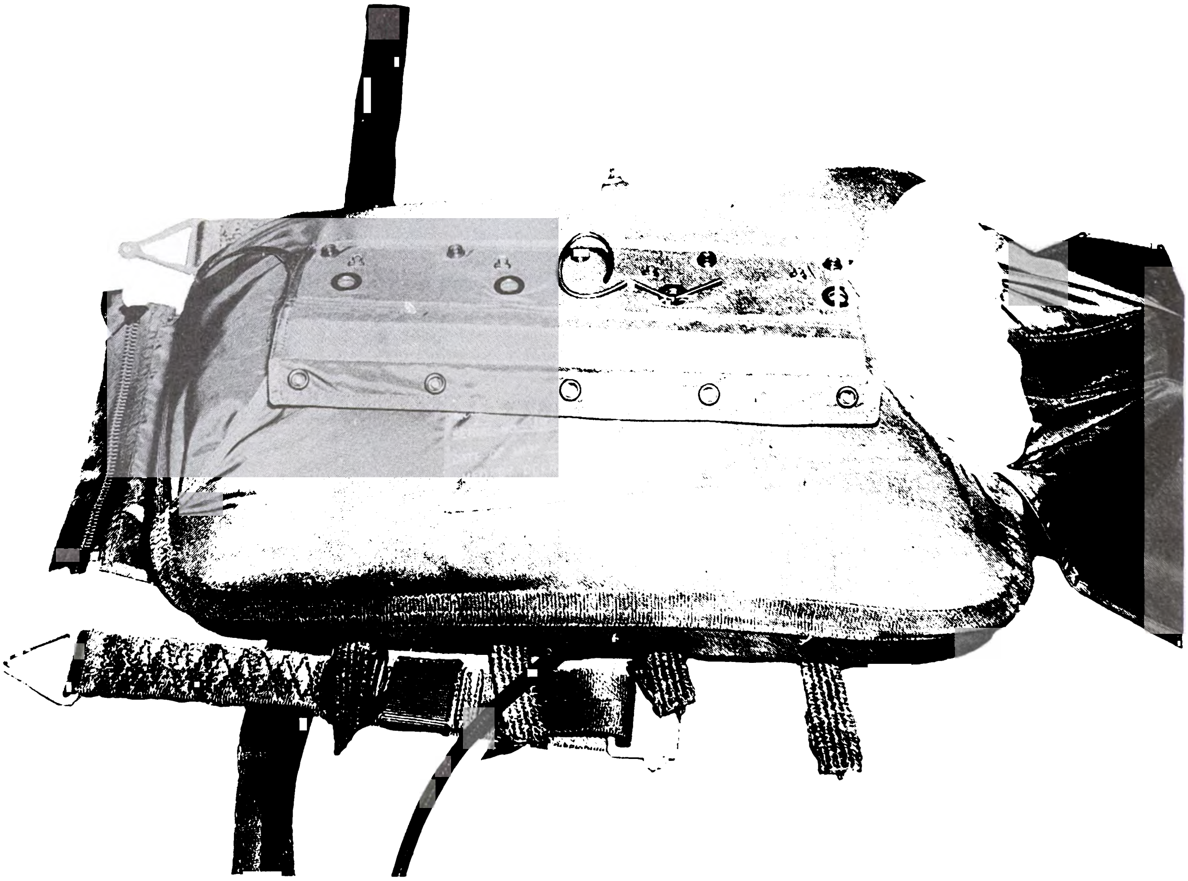


Figure 9-20. —Temporary locking pin inserted.

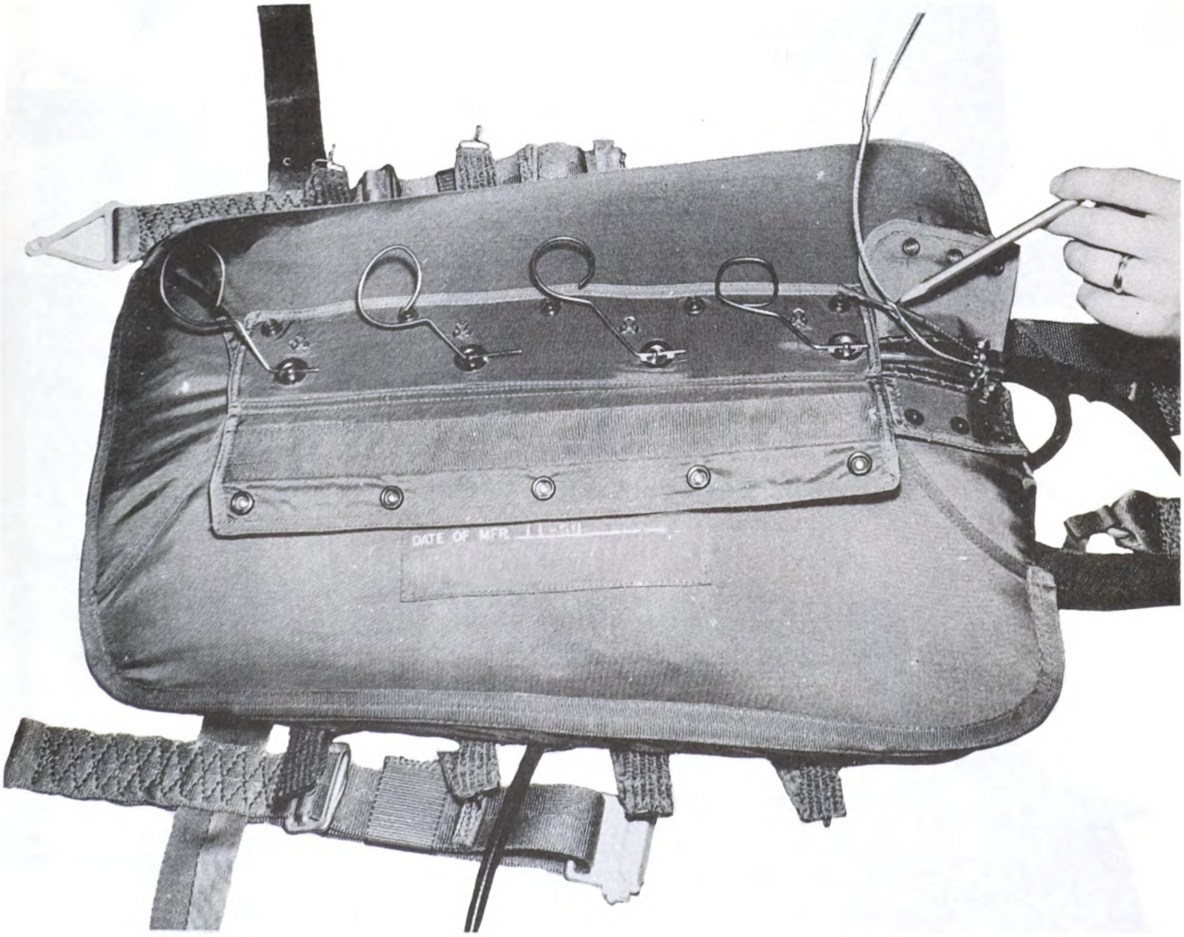


Figure 9-21. —Top ripcord locking pin in automatic actuator power cable terminal eye.

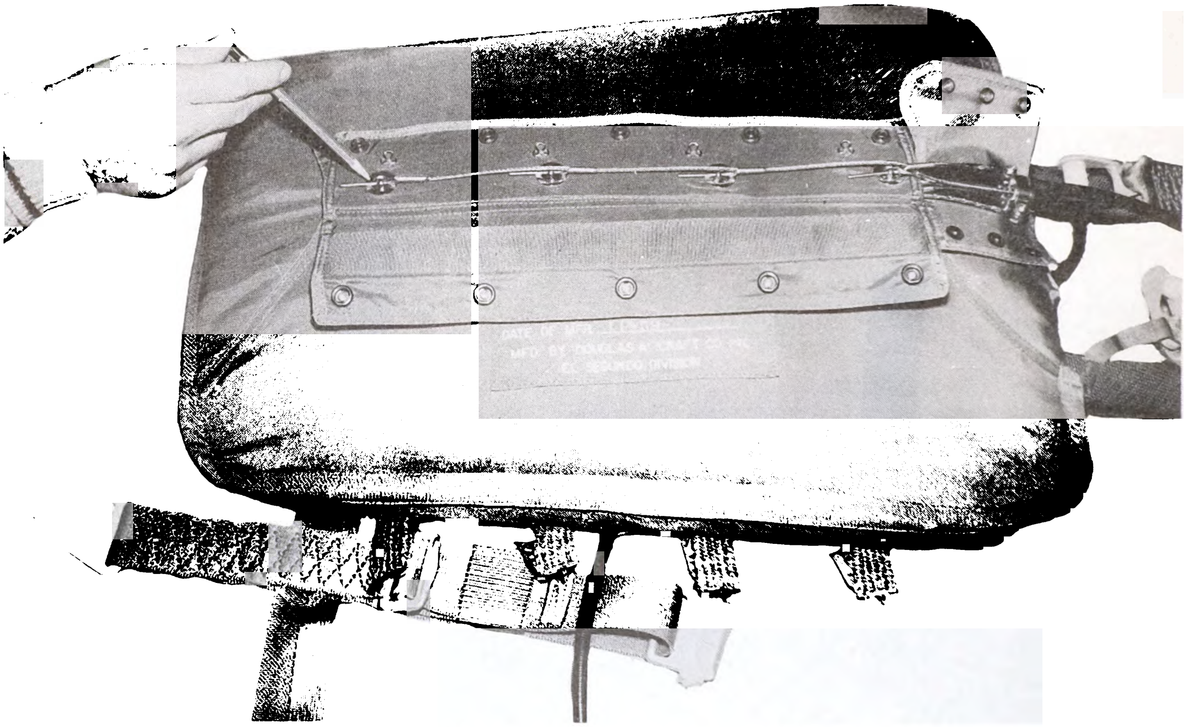


Figure 9-22. —Bottom locking pin safety-ties with size A nylon thread.

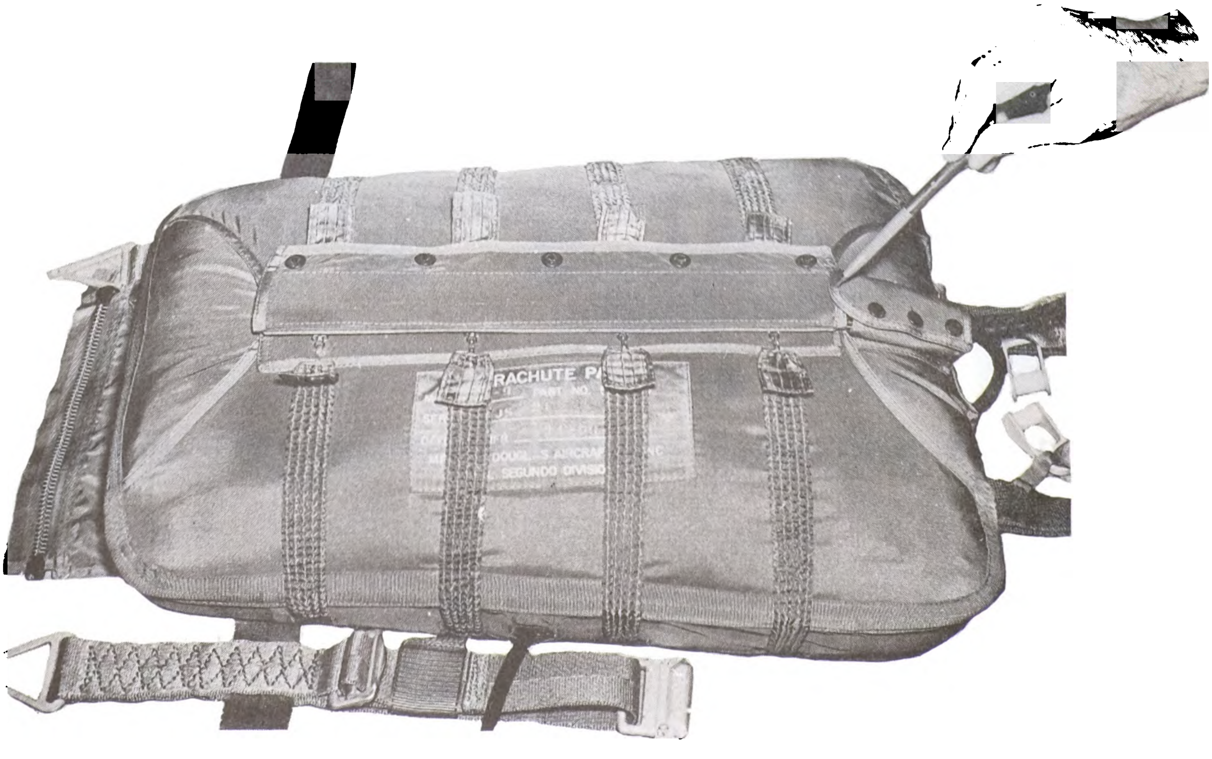


Figure 9-23. —Cover placed over ripcord protector flap.

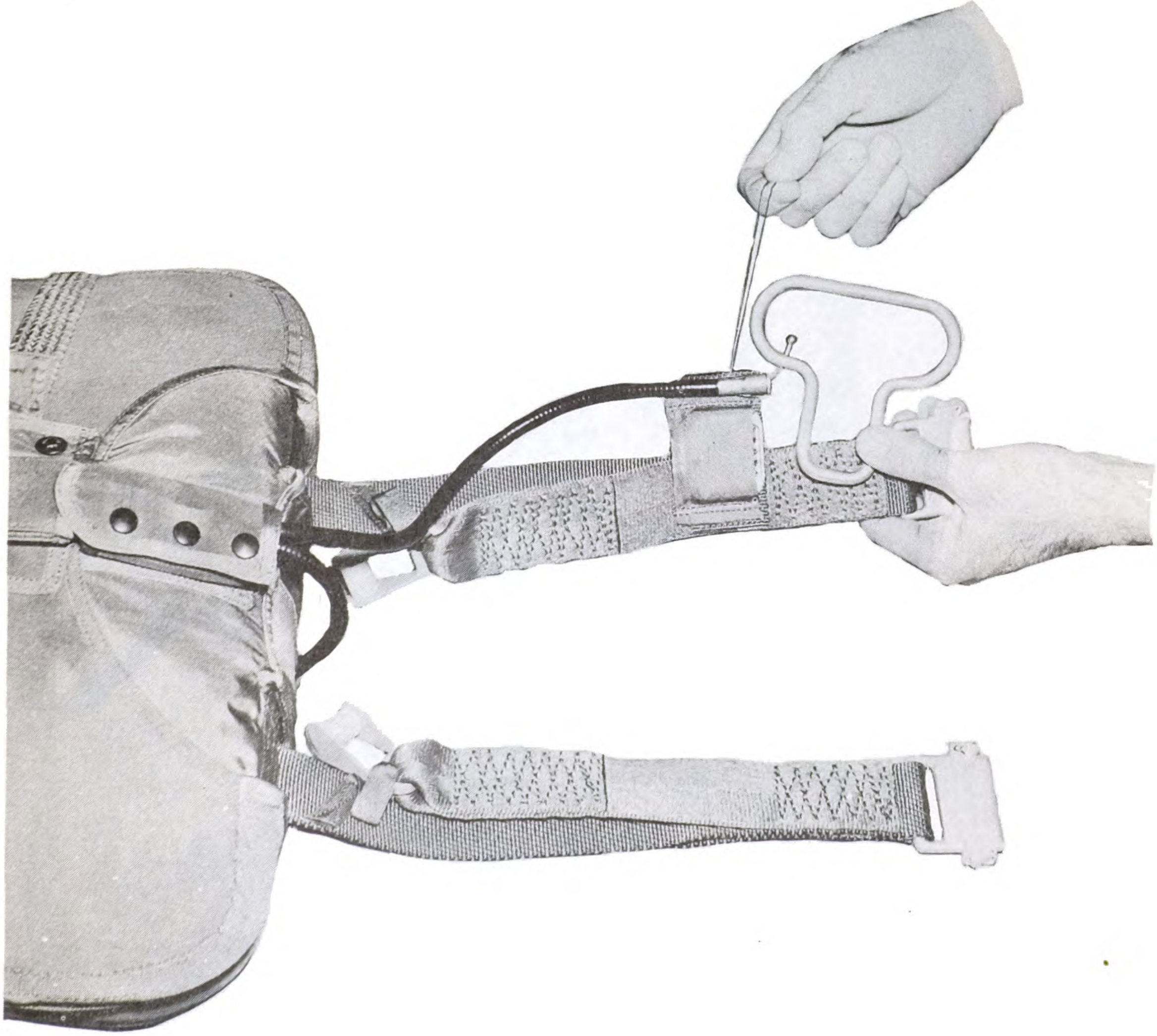


Figure 9-24. —Safety-tie clip with size A nylon thread.

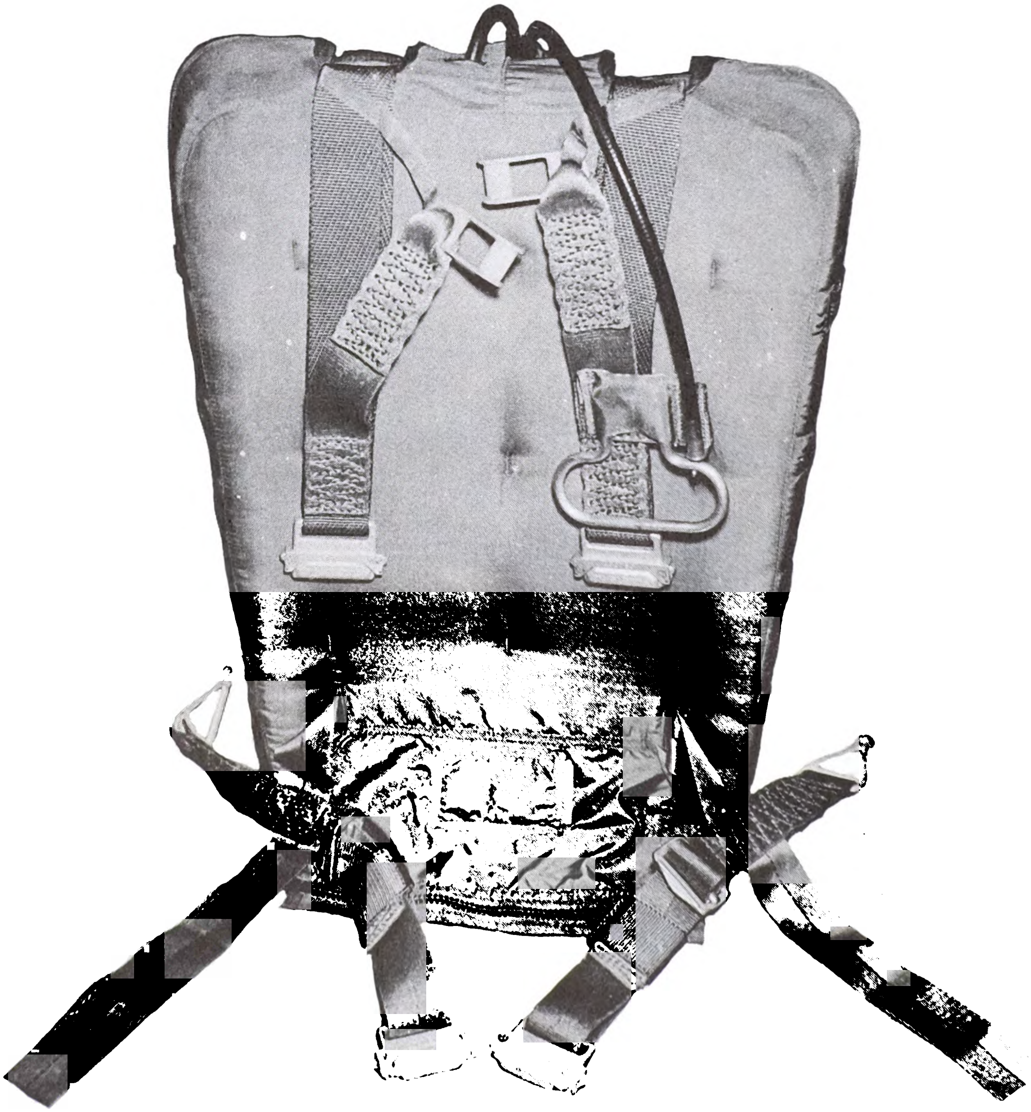


Figure 9-25. —Ripcord and Parachute Record Card stowed.

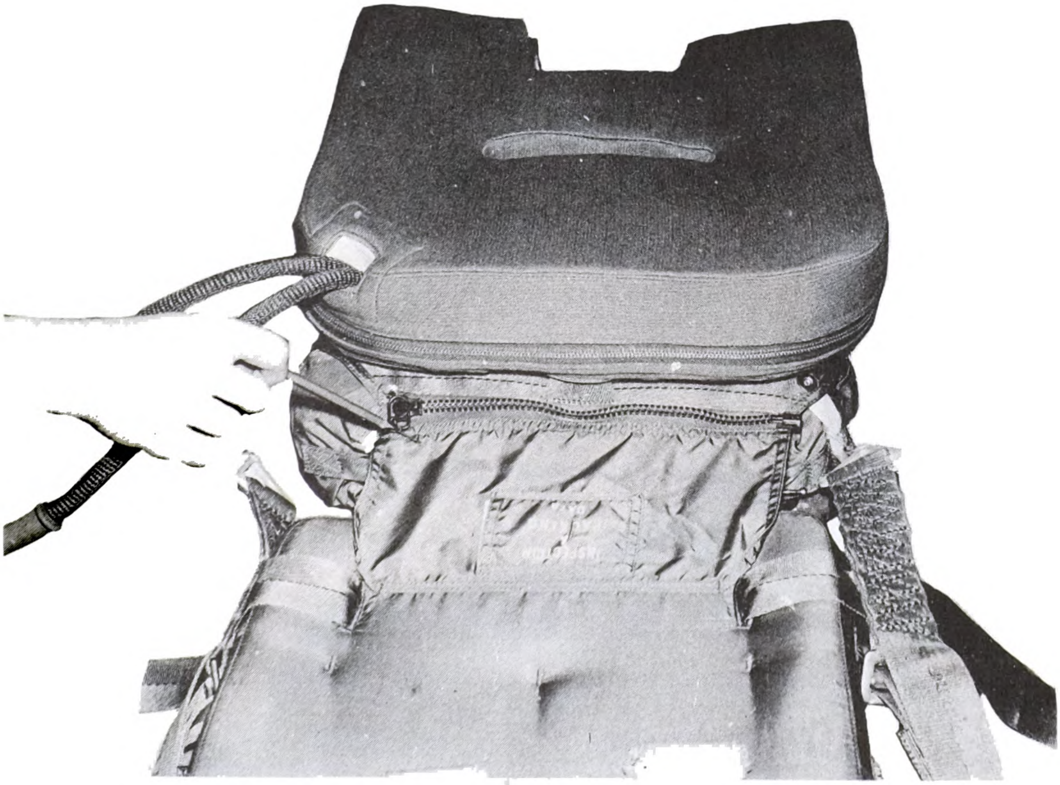


Figure 9-26.—Slider safety-tied with two turns of 6-cord nylon.

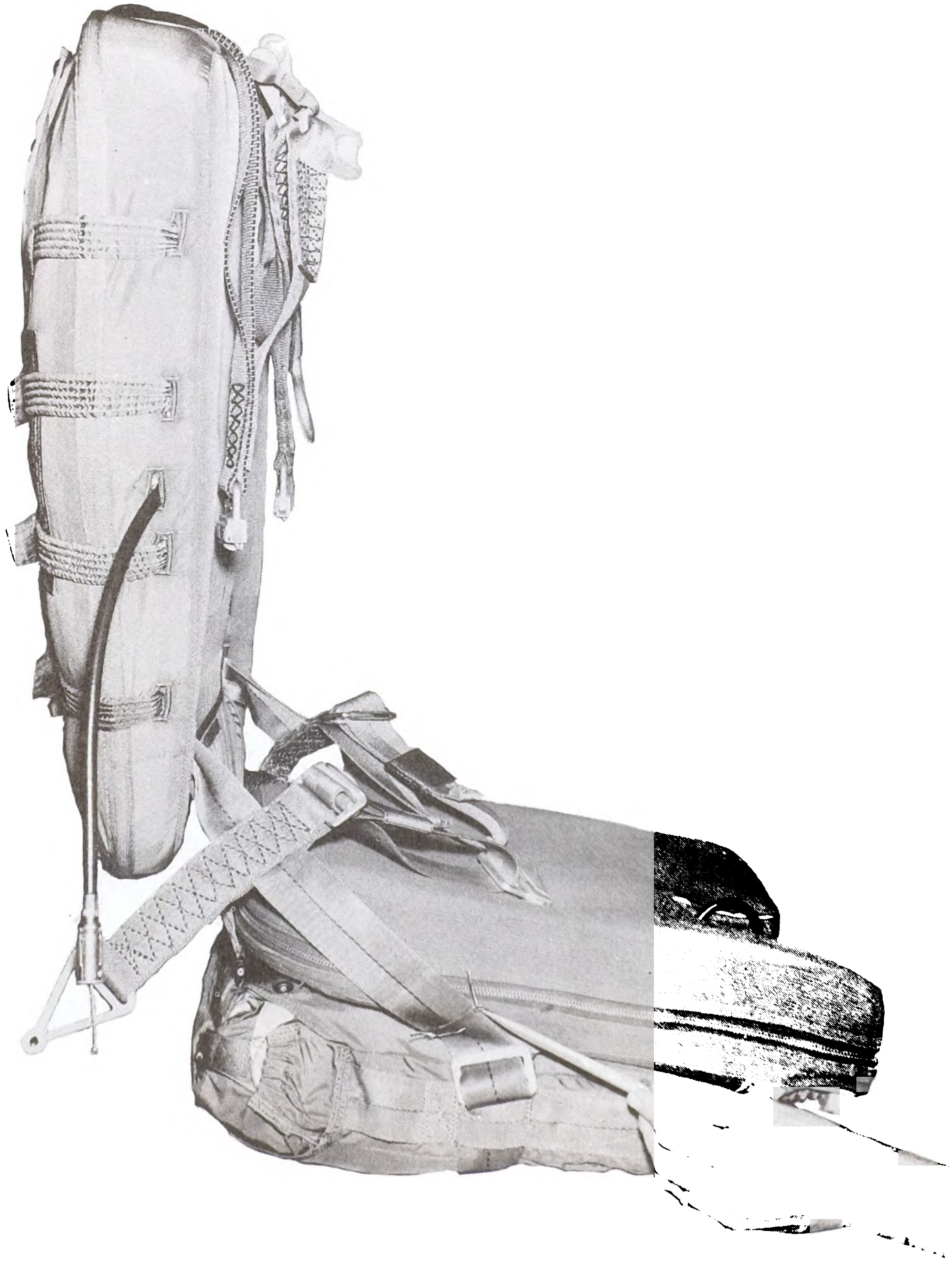


Figure 9-27.—Webbing safety-tied with two turns of 6-cord nylon.

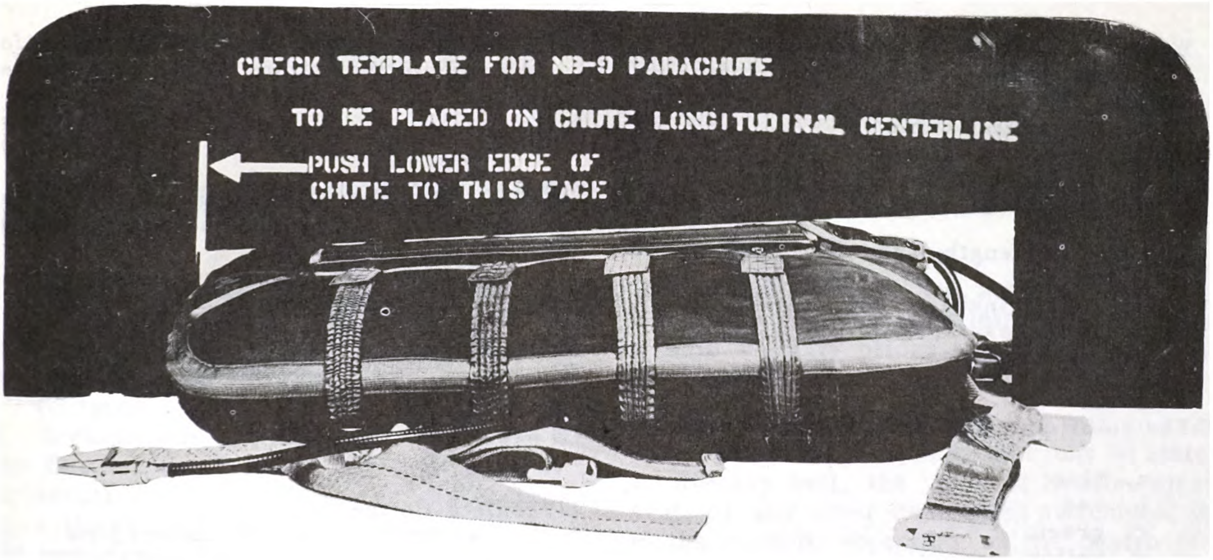

CHECK TEMPLATE FOR NB-9 PARACHUTE
TO BE PLACED ON CHUTE LONGITUDINAL CENTERLINE
PUSH LOWER EDGE OF CHUTE TO THIS FACE

Figure 9-28. —Check template for NB-9 parachute.

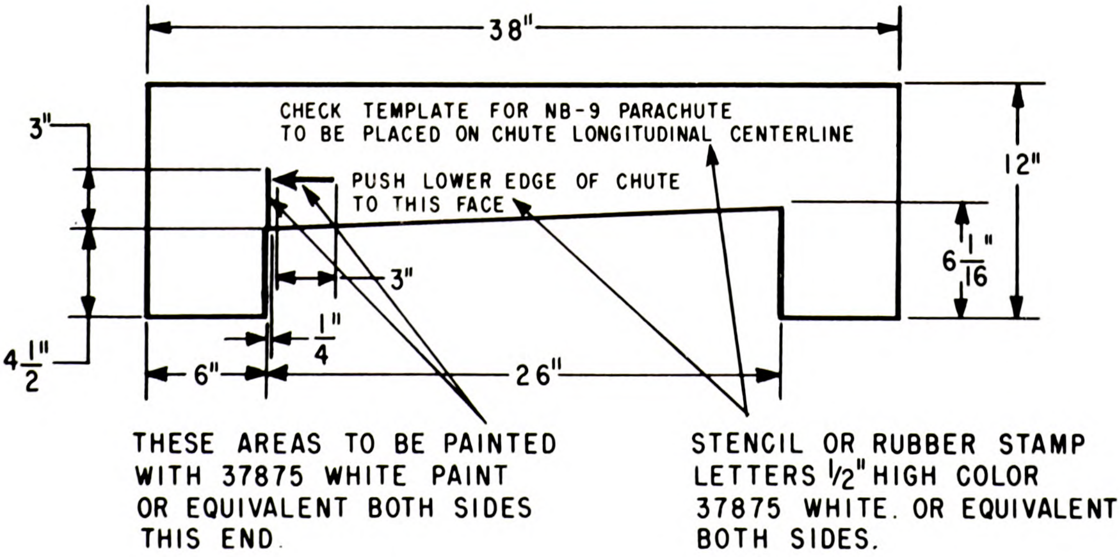

38"
CHECK TEMPLATE FOR NB-9 PARACHUTE
TO BE PLACED ON CHUTE LONGITUDINAL CENTERLINE
PUSH LOWER EDGE OF CHUTE
TO THIS FACE
12"
3"
3"
$6\frac{1}{16}$"
$\frac{1}{4}$"
$4\frac{1}{2}$"
6"
26"
THESE AREAS TO BE PAINTED WITH 37875 WHITE PAINT OR EQUIVALENT BOTH SIDES THIS END.
STENCIL OR RUBBER STAMP LETTERS 1/2" HIGH COLOR 37875 WHITE. OR EQUIVALENT BOTH SIDES.

Figure 9-29. —Check template details.

QUIZ

1. When opening a NB-9 parachute for repacking, with a Master Specialties actuator installed, pull
    - a. the arming cable
    - b. the manual ripcord
    - c. the ripcord pins
    - d. any of the above
2. The tied off length of the pilot chute bridle cord is
    - a. 21-1/2 inches
    - b. 36 inches
    - c. 36-1/2 inches
    - d. 42 inches
3. The color code of the Mk V Mod 0 cartridge is
    - a. blue
    - b. red
    - c. green
    - d. yellow
4. The time delay of the Mk V Mod 0 cartridge is
    - a. 3/4 second
    - b. 1 second
    - c. 2 seconds
    - d. 3 seconds
5. The risers on the RAPEC parachute are attached to the container with the
    - a. top set of riser snaps to the top set on the container
    - b. top set of riser snaps to the lower set on the container
    - c. lower set of riser snaps to the top set on the container
    - d. lower set of riser snaps to the lower set on the container
6. The first bight of suspension lines is located furthest from the canopy on the
    - a. packer's left-hand side
    - b. helper's left-hand side
    - c. packer's right-hand side
    - d. helper's right-hand side
7. The distance that the suspension lines extend beyond the hesitator loops is
    - a. 1/2 inch
    - b. 1 inch
    - c. 2 inches
    - d. 3 inches
8. When stowing the canopy, the number of folds brought to the bottom of the container is
    - a. 1
    - b. 2
    - c. 3
    - d. 4
9. The pilot chute is positioned on the top of the folded canopy with the cone in line with the
    - a. first grommet from the top
    - b. second grommet from the top
    - c. third grommet from the top
    - d. fourth grommet from the top
10. The clip is safety-tied with size___thread.
    - a. A
    - b. B
    - c. E
    - d. FF
11. Safety-tie the
    - a. first and fourth ripcord pins
    - b. first and second ripcord pins
    - c. fourth ripcord pin
    - d. first ripcord pin
12. In relation to the ripcord protector flap, the housing clamp cover should be
    - a. over the flap
    - b. under the flap
    - c. flush with the flap
    - d. 1/8 inch away from the flap
13. The width at the bottom of a packed NB-9 is
    - a. 3 inches
    - b. 4-1/2 inches
    - c. 6 inches
    - d. 1/2 inches
14. Why is it important for the NB-9 to be packed as flat as possible?
    - a. To maintain adequate knee clearance during ejection
    - b. To provide good compatibility with the headrest for scanning the instruments during catapult launching
    - c. To minimize rocking of the parachute against the seat back
    - d. All of the above
15. When attaching the pararaft kit and seat pan to the NB-9, the free end of the webbing should extend beyond the edge of the adapter
    - a. 1 inch
    - b. 1-1/8 inches
    - c. 1-1/2 inches
    - d. 1-5/8 inches

CHAPTER 10

AUTOMATIC PARACHUTE ACTUATORS

The automatic parachute actuator is designed to increase the chances of survival after bailout or ejection from an aircraft. It does not interfere with the manual ripcord system.

Two types of automatic parachute actuators are currently used by the Navy. They are the Irvin Barometric Release, Mk V, powered by a mechanical compression spring and equipped with a timer; and the Master Specialties, Type 1000 series, powered by a time-delay explosive cartridge. Both actuators can be opened either automatically or manually.

Both types of automatic parachute actuators are equipped with an altitude-sensing aneroid and are designed to prevent automatic deployment of the parachute above a preset altitude. The actuators are normally set to operate at 10,000 feet, which is considered safe for deployment of the parachute without excessive damage to the parachute or physical danger to the parachutist because of the opening shock force. When bailout or ejection occurs below 10,000 feet (the preset altitude), the actuator provides the necessary time delay, allowing deceleration to a safe velocity before the parachute is automatically deployed.

Both actuators are equipped with an arming cable connector assembly that may be attached to the lap belt, the ditching handle, ejection seat, or any other designated attachment point in the cockpit, depending on the design of the aircraft.

When separation occurs, the actuator is armed. Figure 10-1 shows the types of arming cable connector assemblies that may be used. Figure 10-2 shows an arming cable connector assembly attached to an automatic lap belt. Figure 10-3 shows the swage-ball-terminal end fitting attached to the ditching handle of a fully integrated seat. Either the Mk V or the Master Specialties actuator may be used with any seat type or back type parachute, the aircraft seat being the determining factor.

Irvin Barometric Release, Mk V

OPERATION

The Irvin Barometric Release, Mk V, is initiated by a heavy compression spring which, when released, forces the power cable into the spring cover, pulling the parachute ripcord as it moves. The spring supplies a force of not less than 150 pounds which is more than adequate to open the parachute. The aneroid assembly controls the power mechanism so that automatic parachute deployment will occur only at, or below, a certain altitude. The altitude is preset on the device by means of a calibrated altitude dial. Figure 10-4 shows the Irvin Mk V actuator with the arming pin installed and the aneroid assembly preventing movement of the gear assembly.

The device incorporates a timer which insures that a certain time interval (normally 2 seconds) occurs between bailout and parachute pack opening, thus eliminating any chance of premature deployment. The timer is started by the altitude dial at an altitude above the desired deployment altitude. This action takes into account the velocity of a free-falling parachutist. When the arming pin is pulled, the aneroid stop will prevent movement of the gear assembly until the preset altitude is reached. If the device is armed below the preset altitude, parachute deployment will occur following the preset time delay which begins immediately upon arming. If the device is armed above the preset altitude, parachute deployment will occur when the parachutist drops to the preset altitude. Figure 10-5

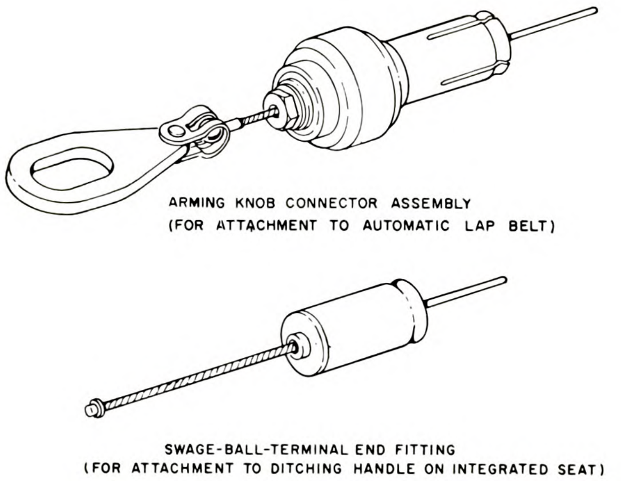

ARMING KNOB CONNECTOR ASSEMBLY
(FOR ATTACHMENT TO AUTOMATIC LAP BELT)
SWAGE-BALL-TERMINAL END FITTING
(FOR ATTACHMENT TO DITCHING HANDLE ON INTEGRATED SEAT)

Figure 10-1.—Automatic parachute actuator arming cable connector assemblies.

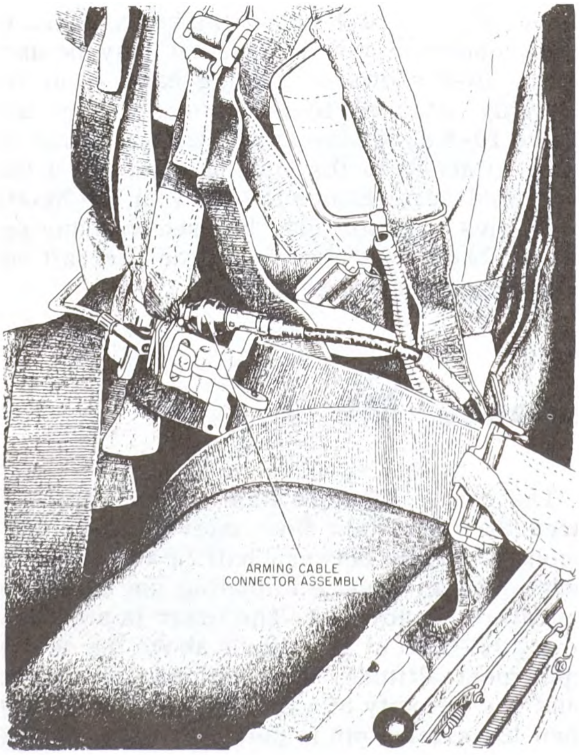


Figure 10-2.—Arming cable attached to automatic lap belt.

shows the Irvin Mk V actuator with its spring assembly released.

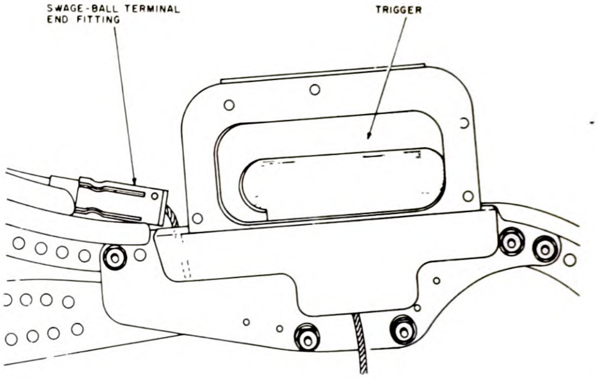


Figure 10-3.—Swage-ball-terminal end fitting attached to ditching handle of fully integrated seat.

INSTALLATION AND MAINTENANCE

The Mk V may be shipped either already mounted in a parachute pack or in a separate box. In either case, the actuator is shipped with the power cable assembly, the power housing assembly, and the arming housing assembly installed on the timer box assembly; the arming knob connector assembly inserted in the arming housing assembly, and the altitude dial set at 10,000 feet.

Installation

1. Unpack the actuator from the shipping box and protective bag.
2. Stitch the mounting plate to the parachute pack, as shown in figure 10-6.
3. Pull the arming knob connector assembly out of the arming housing.
4. Turn the reset stud (fig. 10-7) clockwise to the stop.

CAUTION: When turning the reset stud or altitude dial, always use a properly fitting screwdriver with parallel surfaces on the blade. When turning the reset stud, turn the screwdriver slowly to allow the gears to turn to a definite stop.

5. Insert the arming knob connector assembly (fig. 10-7) into the timer box assembly.
6. Remove the spring cover and compress the compression spring with the arming tool. NOTE: Two arming tools are provided with every 20 units.

7. Reset the altitude dial for 10,000 feet. NOTE: Pointer should be turned well above and then carefully returned to the 10,000-foot mark.

CAUTION: Steps 3 through 6 above, must be performed in the sequence given.

8. Mount the actuator on the parachute pack as shown in figure 10-6, by inserting the tongue into the mounting plate, and secure by inserting the mounting screw.

9. Secure the power housing assembly and power cable assembly to the ripcord housing clamp and ripcord, as shown in figure 10-6.

10. The clamp plate used to hold the power cable housing and the manual ripcord housing should have a cone, part No. ID-54-254-6, inserted up through the hole in the end of the clamp before sewing to the pack when the actuator is used on back packs. Care must be taken to insure that the ripcord pinhole is properly in line. When the actuator is used on seat type packs, no cone is used; the hole in the end of the clamp is used as a grommet to fit over the cone on the side flap of the pack.

NOTE: *Aviation Clothing and Survival Equipment Bulletin* No. 27-57 describes the step-by-step procedure for installation of the actuator in the NS-3 seat type parachute assembly.

Aviation Clothing and Survival Equipment Bulletin No. 25-57 gives the procedure for inspecting, maintaining, and packing the NB-5 and NB-7 back type parachute assemblies equipped with automatic actuators.

Aviation Clothing and Survival Equipment Bulletin No. 10-57 provides for selection of the proper arming cable connector.

Maintenance

Troubles most commonly encountered with the Mk V actuator are listed in table 10-1, along with probable causes and recommended remedies. You will note that most of the troubles are remedied by replacing one of the components. The replacement procedures for the components

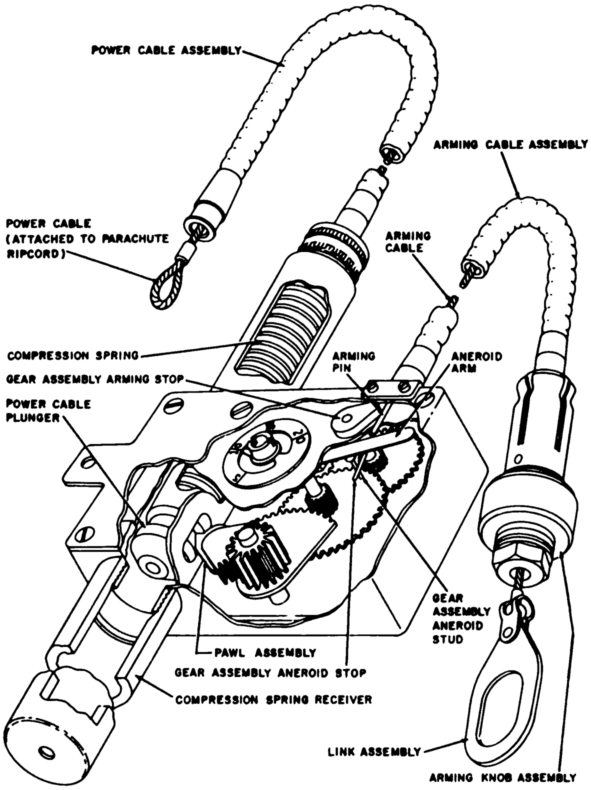


Figure 10-4.—Irvin Mk V Automatic Parachute Actuator in secured position.

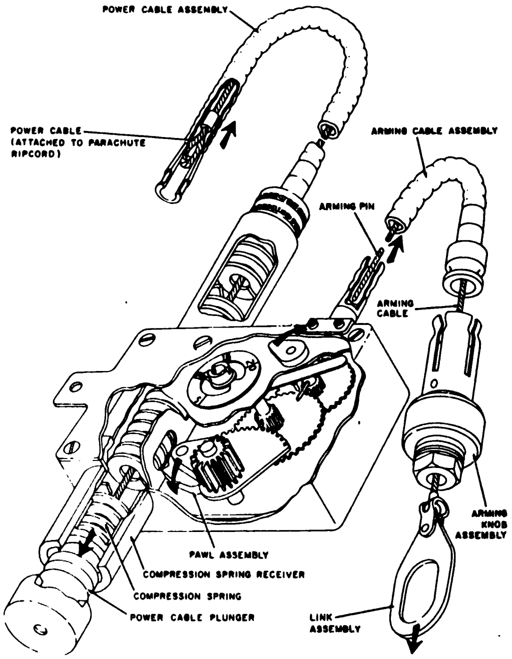


Figure 10-5.—Irvin Mk V Automatic Parachute Actuator with spring assembly released.

referred to in the troubleshooting chart are as follows:

Remove the arming knob connector assembly by exerting a 15- to 20-pound force and extracting the arming housing assembly. Install by inserting into arming housing assembly and making sure it is properly inserted into the timer box assembly. It must extend at least 1/8 inch, and no more than 1 inch, beyond the case.

Remove the arming housing assembly by removing the three screws and lockwashers. Install in the reverse order of removal.

Remove the power housing assembly by removing the conduit coupling nut. Install in the reverse order of removal.

Remove the power cable assembly by removing the spring cover and plunger from the spring housing. Install in the reverse order of removal.

To remove the timer box assembly, remove the arming knob connector assembly, arming housing assembly, power housing assembly, and the power cable assembly, as described above. Install in the reverse order of removal.

Table 10-2 lists the inspections which should be performed on the various components of the actuator.

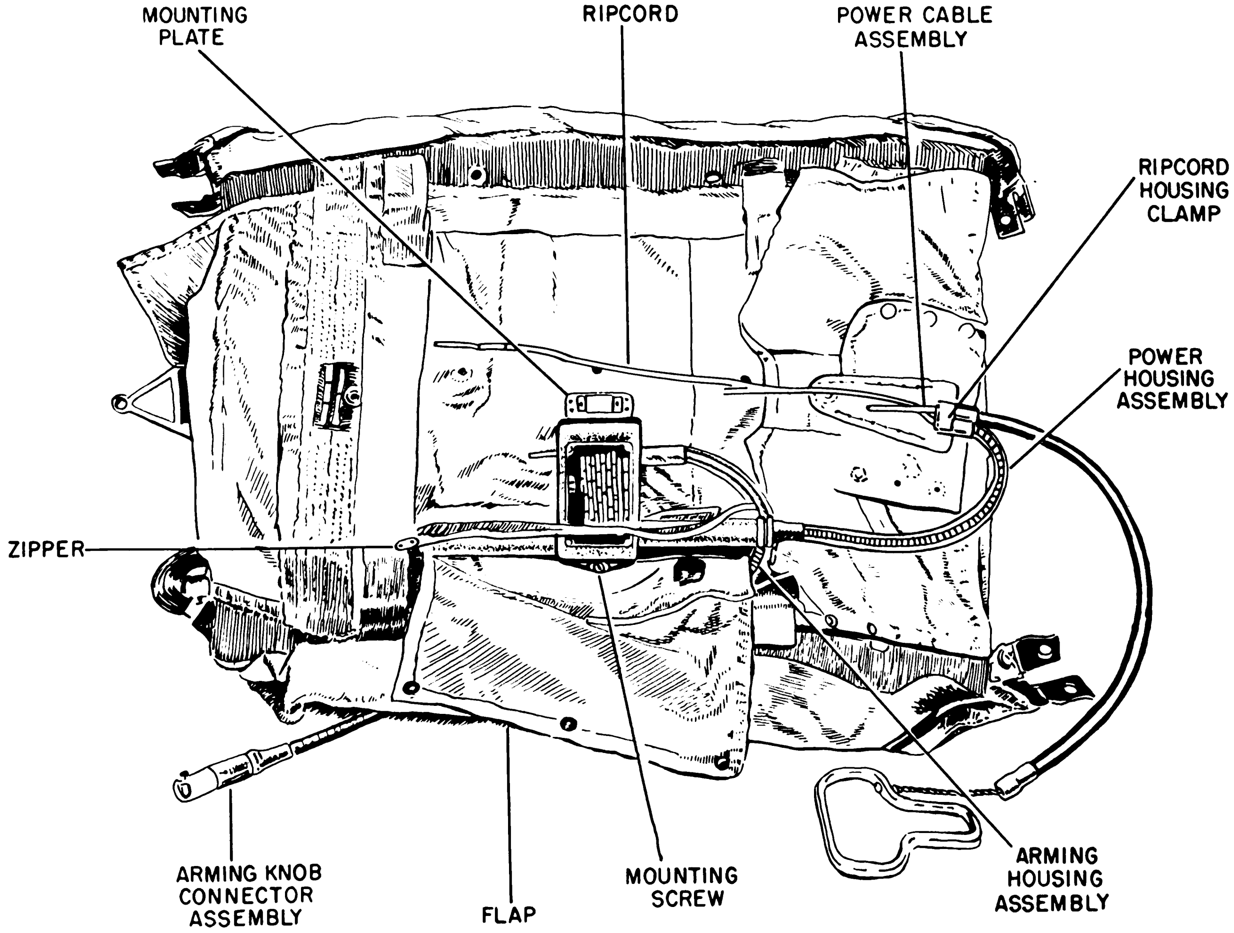


Figure 10-6.—Mk V barometric release installed in typical parachute pack.

Table 10-1.--Troubleshooting chart for Mk V parachute actuator.

Trouble	Probable cause	Remedy
With arming knob connector not inserted and altitude dial set at its fully counterclockwise position, reset stud does not rotate.	Defective gear train.	Replace timer box assembly.
Arming knob connector assembly does not insert into timer box assembly.	Bent wire.	Straighten wire before inserting.
	Damaged arming housing assembly.	Replace arming housing assembly.
With reset stud rotated fully clockwise and arming connector assembly inserted, compression spring does not remain compressed.	Defective timer box assembly.	Replace timer box assembly.
	Defective plunger.	Replace plunger.
Power cable assembly does not move when compression spring is compressed.	Broken or excessively stretched cable.	Replace power cable assembly.
	Damaged power housing assembly.	Replace power housing assembly.
Altitude dial cannot be set.	Defective timer box assembly.	Replace timer box assembly.

Table 10-2.--Inspection chart for Mk V actuator.

Component	Nature of inspection	Inspection time
Power cable assembly.	Check for damaged or stretched cable.	Pre-installation.
	Check for proper securing to ripcord.	Post-installation
Power housing assembly.	Check for cracks or fraying.	Pre-installation.
	Check for proper assembly to timer box.	Pre-installation.
	Check for proper securing to ripcord housing clamp.	Post-installation.
Compression spring.	Check for compressed spring. Check for proper spring.	Pre-installation.
Arming knob connector assembly.	Check for damaged or bent cable.	Pre-installation.
	Check for proper insertion into timer box assembly.	Pre-installation.
Arming housing assembly.	Check for cracks or fraying.	Pre-installation.
	Check for proper attachment to timer box assembly.	Pre-installation.
Timer box assembly.	Check for freedom of rotation of reset stud.	Pre-installation.
	Check for existence of nameplate with instructions.	Pre-installation.
	Check for legibility of dial.	Pre-installation.
	Check for proper altitude setting.	Post-installation.
	Check for tightness of spring cover.	Pre-installation.
	Check for loose or missing hardware.	Pre-installation.

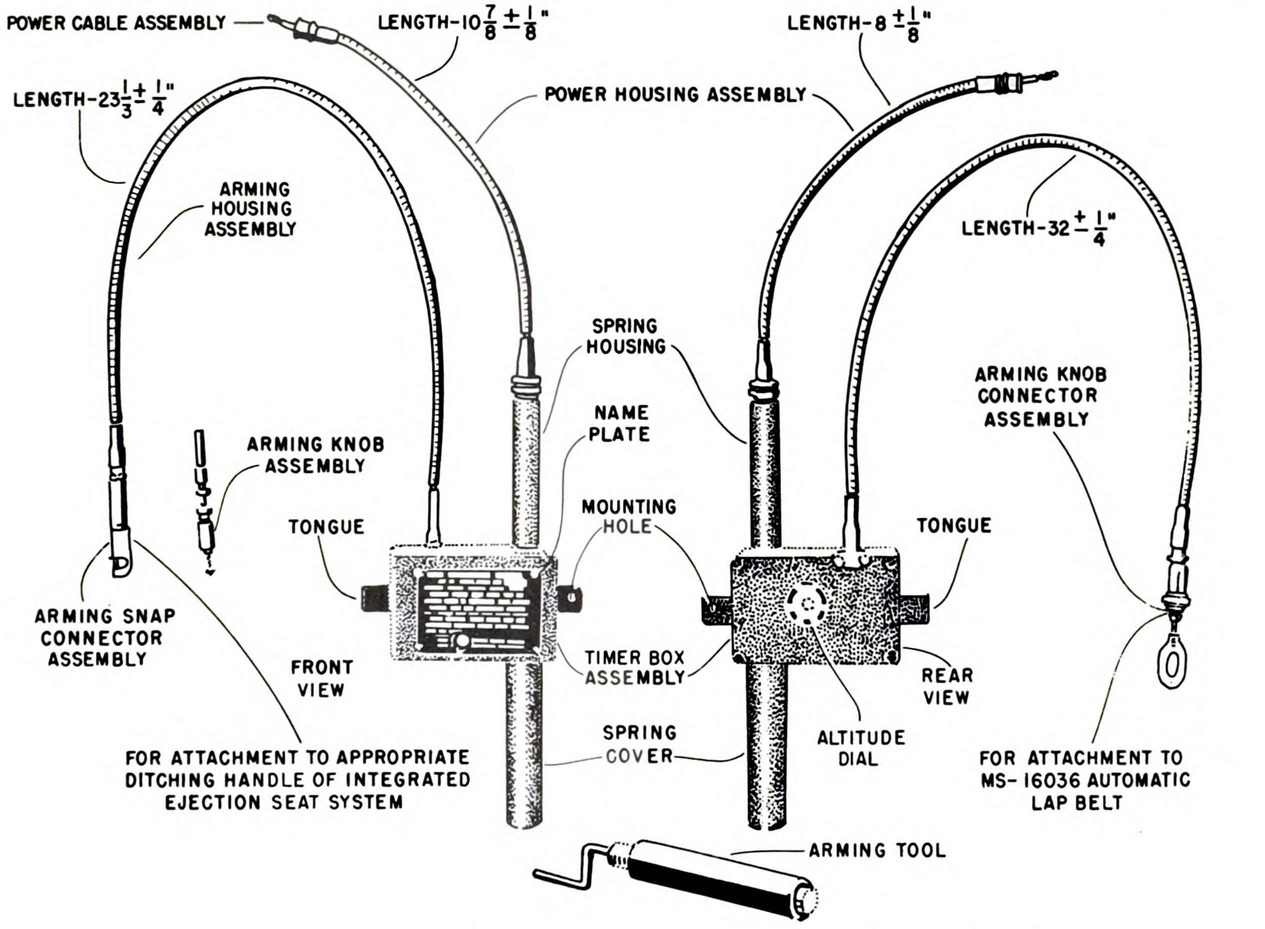


Figure 10-7.—Mk V barometric release, front and rear views.

Master Specialties Parachute Actuator, Type 1000 Series

The Master Specialties actuator is a pyrotechnic device, utilizing energy derived from an explosive cartridge to withdraw the ripcord from a packed parachute. Firing of the cartridge is controlled by an aneroid assembly which functions at a preset altitude (normally 10,000 feet) to release the firing mechanism. Figure 10-8 shows the Master Specialties actuator in the secured position, with the arming pin installed and the aneroid assembly securing the firing mechanism.

The actuator mechanism is enclosed in a protective tube which prevents damage to the parachute or the parachute pack when the device is installed or actuated.

When the arming cable is pulled above the preset altitude, the actuator is armed, but the aneroid bellows latch prevents operation of the firing mechanism until the preset altitude is reached. Figure 10-9 (A) shows the arming pin removed but the aneroid bellows latch is securing the firing mechanism. Figure 10-9 (B) shows the firing mechanism completely released when the preset altitude has been reached.

When the arming cable is pulled below the preset altitude, immediate operation of the firing mechanism occurs. This is caused by the aneroid bellows latch assembly automatically unlocking at the preset altitude.

Operation of the firing mechanism initiates action which results in the explosion of a main powder charge in the cartridge after a time interval of 2 or 3 seconds, depending on the designated cartridge used. This delayed explosion forces the piston and its attached power cable to move forward. The forward movement of the power cable (with the attached parachute ripcord) results in opening of the parachute pack and release of the parachute. Figure 10-10 shows the power cable at its extreme forward position.

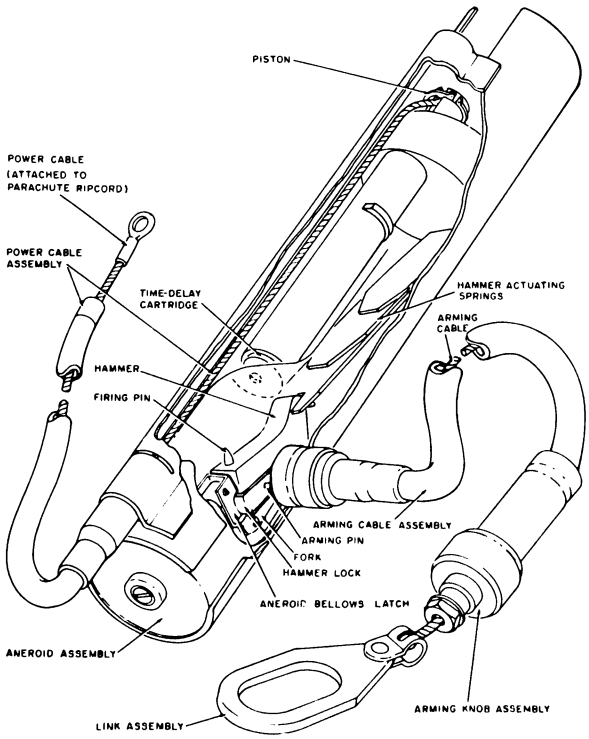


Figure 10-8.—Master Specialties actuator in the secured position.

PREPARATION FOR USE

Upon removal of the actuator from the shipping carton, the exterior parts of the unit should be inspected for damage during shipping and storage. An inspection should be made for corrosion, dirt, dents, and cracks.

Loading

To load the actuator, proceed as follows:

Remove the screw (3) and washer (4) from the cover assembly (fig. 10-11). Slide the receiver assembly from the cover assembly and check the position of the hammer assembly. If the hammer assembly is not in the position shown in figure 10-12, completely separate the barrel assembly from the receiver assembly and allow the hammer assembly and lock to drop into the armed and cocked position.

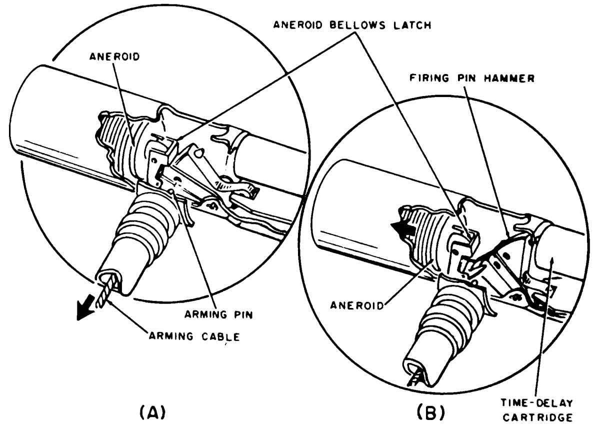


Figure 10-9.—Master Specialties actuator.
(A) Arming pin removed:
(B) firing mechanism released.

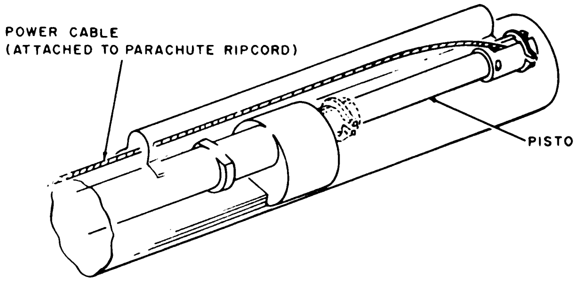


Figure 10-10.—Master Specialties actuator, power cable at extreme forward position.

Insert the pin of the arming pin assembly (24, fig. 10-11) through retainers (34). The pin must pass through the holes in the lock (28).

With the hammer assembly secured in the armed position, reassemble the barrel assembly to the receiver assembly.

WARNING: Engage the forked end of the longest spring of the barrel assembly with the pin on the hammer assembly so that hand pressure is needed to press the barrel into the recess

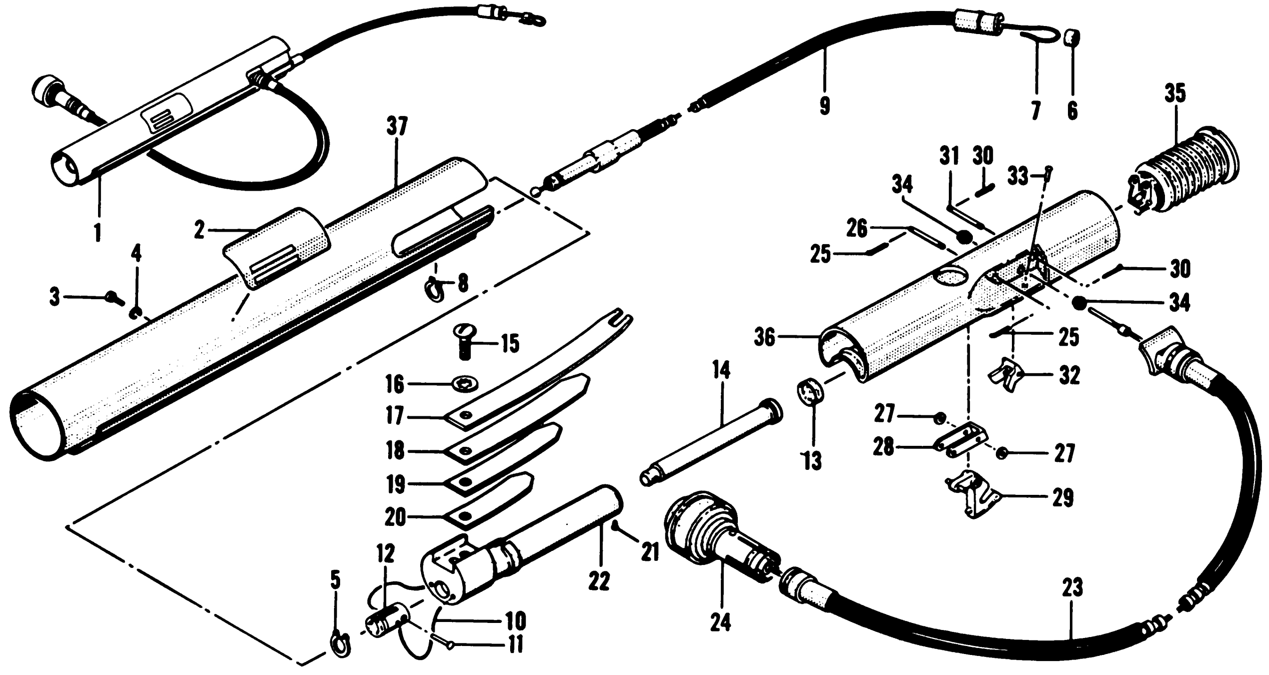


Figure 10-11.—Master Specialties parachute actuator.

1. Actuator assembly.
2. Nameplate.
3. Screw.
4. Washer.
5. Ring.
6. Sleeve.
7. Ball and cable assembly.
8. Ring.
9. Housing assembly.
10. Wire.
11. Rivet.
12. Socket.
13. Seal.
14. Piston.
15. Screw.
16. Washer.
17. Spring.
18. Spring.
19. Spring.
20. Spring
21. Rivet.
22. Barrel.
23. Housing assembly.
24. Pin assembly.
25. Pin.
26. Pin.
27. Spacer.
28. Lock.
29. Hammer assembly.
30. Pin.
31. Pin.
32. Latch.
33. Rivet.
34. Retainer.
35. Aneroid assembly.
36. Receiver.
37. Cover assembly.

of the receiver assembly. If the spring is inadvertently positioned under the hammer assembly pin, the unit will not operate.

Insert a cartridge in the barrel (fig. 10-13) and press the barrel into the recess of the receiver assembly. Slide the receiver assembly into the cover assembly, exercising care that the base of the housing assembly is properly aligned with the barrel assembly and the cover assembly. (See fig. 10-14.)

WARNING: Exercise extreme caution after the cartridge has been inserted in the barrel. Do not allow either end of the cover assembly to be pointed towards the face as flame and smoke may result in impairment of vision in the event of accidental misfire.

Install the washer and screw in the cover assembly.

Installation

Connect the loop at the end of the power cable assembly to the parachute ripcord.

Attach the parachute actuator to the parachute pack in accordance with the instructions contained in the applicable *Aviation Clothing and Survival Equipment Bulletin.*

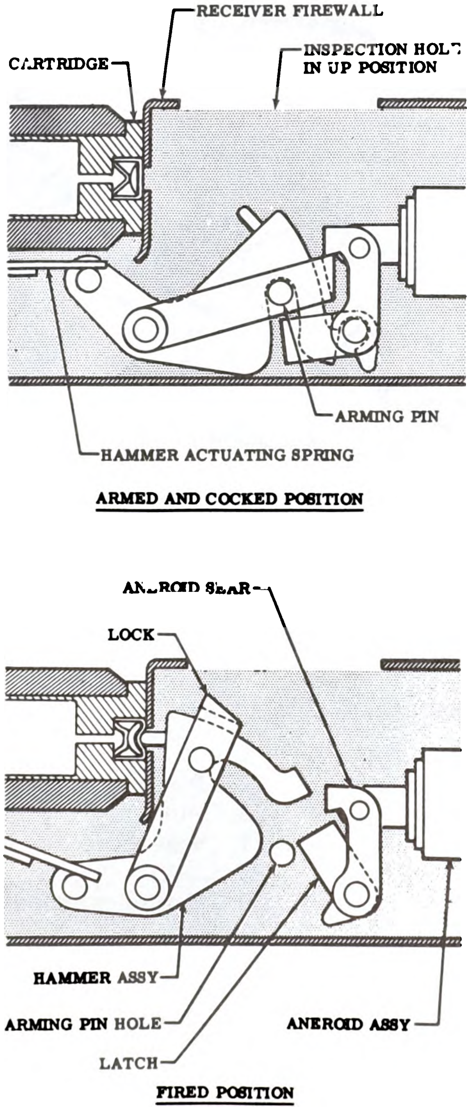


Figure 10-12.—Firing mechanism.

MAINTENANCE

Maintenance on the Master Specialties parachute actuator by operating activities is limited to the replacement of exploded or outdated cartridges, and to the visual inspection and replacement, when necessary, of seal and cartridge, after firing.

WARNING: Do not attempt to remove the aneroid assembly from the receiver nor attempt to make any adjustments to the aneroid assembly and the sear. The complete unit should be returned to the Supply department when serviceability is questioned.

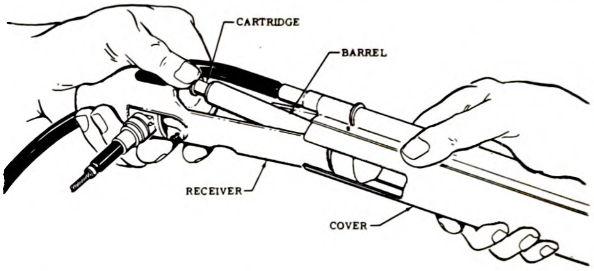


Figure 10-13.—Installing cartridge in barrel.

Replacement of Cartridge

In the event that an exploded cartridge is stuck in the barrel, the following procedure should be followed.

Mount the barrel assembly in a vise with wooden blocks between the vise jaws and the barrel assembly. Insert the blade of a screwdriver between the barrel and cartridge rim so that the screwdriver is inclined approximately 45 degrees toward the barrel assembly. Tap the butt of the screwdriver lightly with a mallet and move the screwdriver blade around the cartridge rim between taps as the expended cartridge is extracted.

The barrel must be cleaned and the seal replaced after each firing of the cartridge. Remove the rivet (11, fig. 10-11) and socket (12). Remove piston (14) from the barrel and rivet assembly. In the event that the seal is congealed, mount the barrel and rivet assembly in a vise with protective wooden blocks between vise jaws and barrel. Use a rawhide mallet to carefully drive the shaft of the piston through the barrel and rivet assembly. Use a 1/4-inch punch to drive the piston out of the barrel and piston assembly.

Carefully clean the piston face with a knife blade so that no plastic, powder, or dirt remain. If the periphery of the piston requires cleaning, use the same care in cleaning it.

Swab the bore of the barrel and rivet assembly with a stiff bristle brush which has been dipped in a solution of water and mild soap, until no evidence of dirt is visible.

After the cleaning operation, check the vent for obstructions by closing the cartridge end of the barrel and rivet assembly and applying dry, filtered air at approximately 50 p.s.i. to the base end of the barrel and rivet assembly. If the vent is clogged and air does not flow through the hole between the piston and springs, it will be necessary to remove the screw (15,

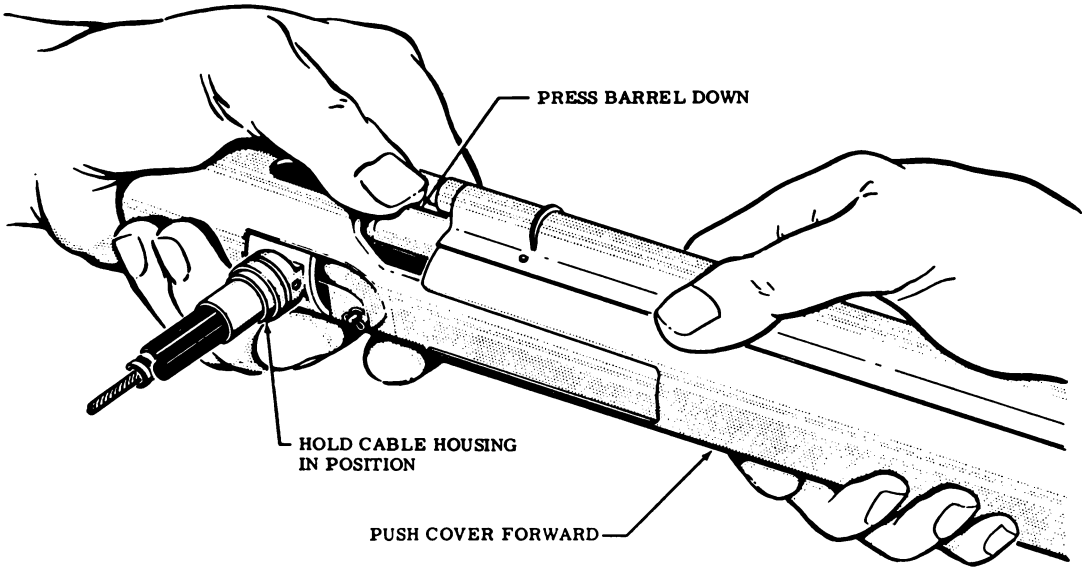


Figure 10-14.—Final assembly procedure.

fig. 10-11), washer (16), and springs (17, 18, 19, and 20). After removal of the springs, ream the vent through both vertical and horizontal passages, using a 0.093-inch diameter reamer or a No. 42 drill.

CAUTION: Do not ream or drill the threaded hole for the spring retaining screw. Remove all chips and dirt from the vent after reaming.

Reassemble the unit, observing all previously mentioned safety precautions. Lockwire the piston assembly to the barrel assembly before final assembly with 0.032 soft copper wire (no substitute).

Minor Repairs, Parts Replacement, and Inspection

Minor repairs are limited to the removal of dents in the cover assembly and replacement of the sleeve on the power cable assembly.

Parts replacement are limited to the replacement of the sleeve on the power cable assembly and the seal in the barrel.

The actuator must be given a physical inspection prior to each flight as follows:

Inspect the cover assembly for dents, foreign matter, and corrosion.

Inspect the sleeve which secures the loop at the end of the power cable for security and tightness. Inspect the cable loop for broken wires and corrosion.

Inspect cable housing assemblies for cracks, defects, and for dents or other damage which might impair operation of the unit.

Troubleshooting

Table 10-3 lists the most common troubles, along with the probable causes and remedies.

Modifications

All Master Specialties actuators in the 1000A, 1000B, and 1000C series must be modified in accordance with *Aviation Clothing and Survival Equipment Bulletin* No. 14-60. This modification involves installing a hammer-actuating spring guide, replacing the existing piston and socket, and installing a plug in the end of the cover assembly. (See fig. 10-15.)

If this modification has already been made, the letters "MOD" will be found on the rear of the receiver assembly beside the nameplate on all model 1000A, 1000B, and 1000C actuators. On all model 1000D actuators, this change has been incorporated by the manufacturer.

Table 10-3.--Troubleshooting chart for Master Specialties actuator.

Trouble	Probable Cause	Remedy
Sear engages lock at altitude less than 10,000 feet.	Aneroid assembly leaks. Aneroid assembly bent.	Return to Supply. Return to Supply
	Receiver housing bent.	Return to Supply.
Power cable or arming pin cable stuck in housing assembly.	Housing assembly damaged.	Return to Supply.
	Cable assembly defective.	Return to Supply.
Cartridge will not fit in barrel.	Wrong size cartridge.	Use recommended cartridge.
	Obstruction in barrel.	Remove obstruction, clean barrel.
Barrel assembly cannot be seated in receiver assembly.	Hammer assembly has not been pinned in armed position and allows firing pin to restrict seating of parts.	Insert arming pin through lock.
Receiver assembly will not fit in cover assembly.	Cover assembly dented or damaged.	Work out minor dents or return unit to Supply.

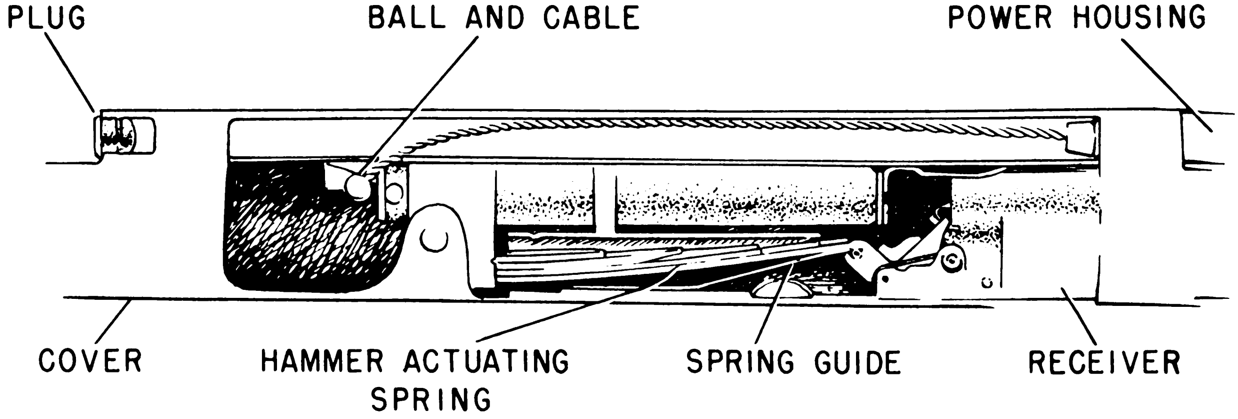


Figure 10-15.—Modified actuator, Master Specialties 1000D.

QUIZ

1. The diameter of the soft copper wire for the 1000 series actuator is ______ inches.
   a. 0.016
   b. 0.025
   c. 0.032
   d. 0.036
2. The cable looped over the ripcord pin to automatically open the parachute is called the ______ cable.
   a. braided
   b. firing
   c. arming
   d. power
3. Before inserting the arming wire on the Irvin Mk V, the
   a. reset stud should be turned clockwise
   b. reset stud should be turned counterclockwise
   c. power spring should be compressed
   d. altimeter should be set to 10,000 feet
4. Above 10,000 feet, the part of the Mk V that keeps the actuator from releasing prematurely is the
   a. thermostat
   b. aneroid
   c. pipe vise
   d. spring compressor
5. To compress the power spring on the Irvin Mk V actuator, it is necessary to use a/an:
   a. arming tool
   b. screwdriver
   c. pipe vise
   d. spring compressor
6. The function of the aneroid, expanded, is to
   a. release the spring
   b. release the timer
   c. keep the timer inoperative
   d. no function when expanded
7. On the Maser Specialties actuator the receiver and barrel assembly is held to the cover by
   a. a screw
   b. a snap ring
   c. copper safety wire
   d. the power cable, locked in the barrel assembly
8. When the reset stud on the Irvin Mk V release is turned, it
   a. winds the spring
   b. arms the timer
   c. cycles the timer
   d. sets the altitude
9. The number of arming tools provided with every 20 Mk V unit is
   a. 1
   b. 2
   c. 3
   d. 4
10. To reset the altitude dial on the Mk V actuator turn the pointer
    a. carefully to the 10,000-foot mark
    b. above, then carefully to slightly below the 10,000-foot mark
    c. above, then carefully back to the 10,000-foot mark
    d. to zero, then carefully back to the 10,000-foot mark
11. The number of types of arming knob connector assemblies is
    a. 1
    b. 2
    c. 3
    d. 4
12. How is the altitude on the Master Specialties actuator reset?
    a. Turn the screw clockwise
    b. Turn the screw counterclockwise
    c. Reset only on the pilot's request
    d. It is never reset
13. When using an Irvin Mk V actuator with an ejection seat system, the length of the arming housing is
    a. 32 inches ± 1/4 inch
    b. 23 inches ± 1/4 inch
    c. 10 7/8 inches ± 1/8 inch
    d. 8 inches ± 1/8 inch

CHAPTER 11

SEWING MACHINE OPERATION AND LUBRICATION

Every parachute loft has a sewing machine section. The number of machines may vary from one in the small loft on an AV to a complete line of multiple-duty machines in a large NAS loft. The sewing section will be organized according to the workload of the activity or activities using the spaces.

The Parachute Rigger is required to perform many repair jobs on parachutes, survival equipment, and associated components. There will also be construction jobs such as fabricating truck and boat covers, awnings, navigation cases, pitot tube covers, or just making a small Bravo flag. The repair work will vary from double patching the canopy, replacing vent rings, and replacing slide fasteners, to fitting flight clothing. Regardless of the sewing job to be performed, in order to have a neat and durable finished product, a complete understanding of the machinery to be used is necessary. A combination of familiarization, practice, and patience will insure safe and efficient operation of any sewing machine.

This chapter covers the standard sewing machines which will be found in most parachute lofts ashore and afloat. By becoming familiar with the basic components of a sewing machine you will find it easier to perform the required daily adjustments and maintenance.

Sewing Machine Familiarization

Sewing machines are divided into two types, OSCILLATING and ROTARY. Both types are operated by electric motors and are fitted with rheostats and special clutch arrangements which enable the operator to control the speed.

Oscillating type sewing machines are named for the action of the sewing hook, which rocks back and forth through half a revolution to complete one stitch.

Rotary type sewing machines are also named for the action of the sewing hook, which makes two complete revolutions to complete one stitch.

The type of stitch commonly used and made by sewing machines in repair work is the lockstitch. The lockstitch makes use of two separate threads. One comes from the spool down through the eye of the needle, the other from the bobbin. In making the lockstitch, these two threads must become interlocked, as shown in figure 11-1.

The thread passing through the eye of the needle is pushed down through the material being sewn. As the needle travels through the material a thread controller spring pulls on the needle thread to prevent any slack that might tangle the thread around the needle.

After the needle reaches its lowest position and starts its upward movement, a small loop of thread forms alongside the needle beneath the throat plate. The sewing hook catches this loop and carries it around the bobbin, which floats in its track in the bobbin case. By locking the loop of needle thread around the bobbin thread, the sewing hook forms the stitch.

As the needle completes its upward movement, the thread tension discs hold the needle thread firmly, and the thread takeup lever, rising quickly pulls on the loop that has been formed and thus tightens the stitch. When the thread takeup lever reaches its highest position, the stitch is completed.

The standard sewing machine has five basic parts; bed, uprise, arm, face, and balance wheel. The BED houses the linkage from the hook driving shaft pulley to the sewing hook assembly; the UPRISE houses the arm shaft connection belt; the BALANCE WHEEL is connected to the arm shaft in the ARM which operates the needle bar mechanism in the FACE of the machine.

The machine is powered by an electric motor, which is connected to the motor driving pulley by a clutch. The motor is connected to the clutch by pressing the forward part of the foot treadle. The aft part of the treadle is the brake which acts upon the clutch.

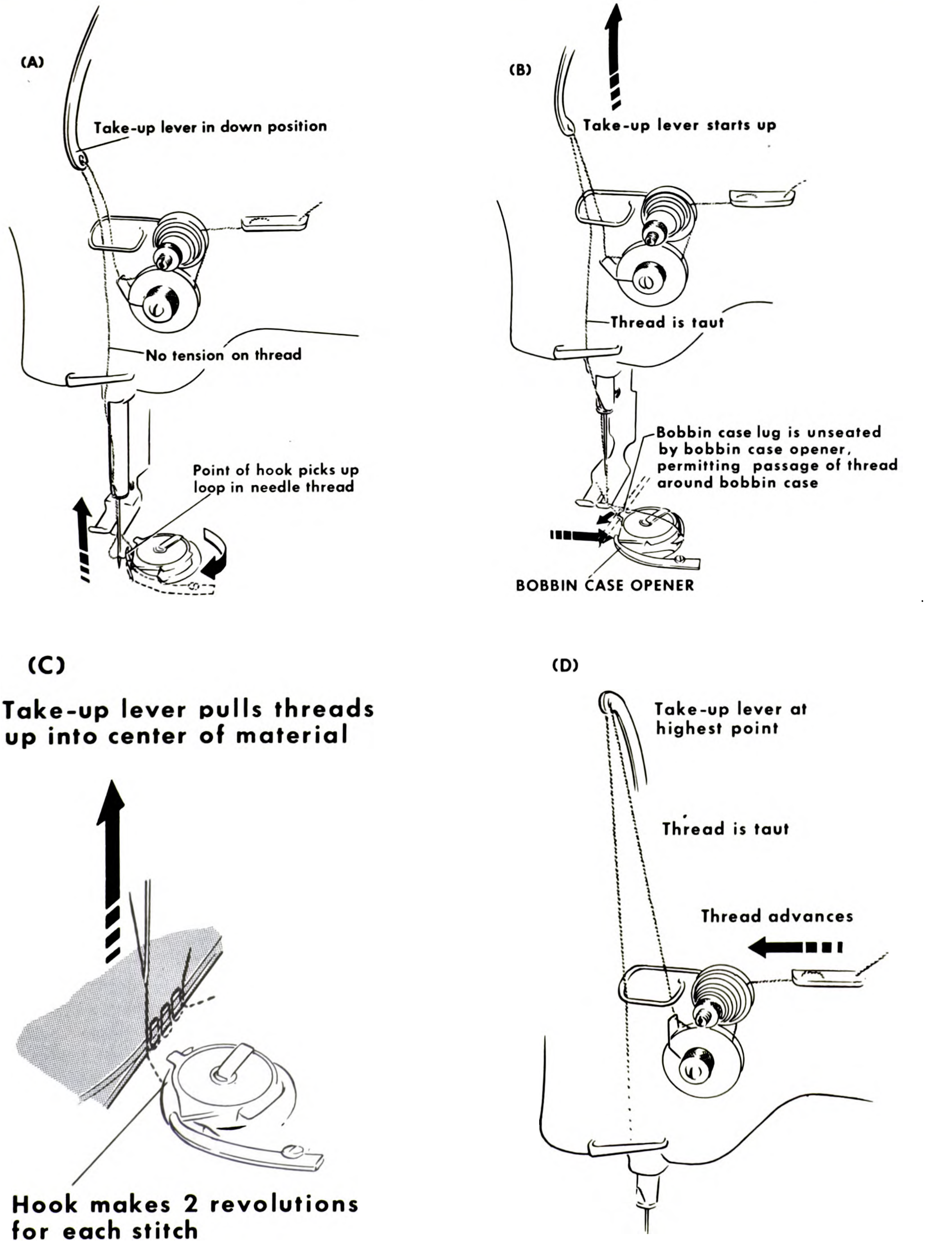

(A)
Take-up lever in down position
No tension on thread
Point of hook picks up loop in needle thread
(B)
Take-up lever starts up
Thread is taut
Bobbin case lug is unseated by bobbin case opener, permitting passage of thread around bobbin case
BOBBIN CASE OPENER
(C)
Take-up lever pulls threads up into center of material
Hook makes 2 revolutions for each stitch
(D)
Take-up lever at highest point
Thread is taut
Thread advances

Figure 11-1.—The lockstitch.

The material to be sewn is held in position on the feed dog by the presser foot. The pressure of the presser foot upon the material enables the feed dog to push the material forward each time the needle goes up. The pressure of the presser foot on the material is released either by a knee lifter or a hand lifter. The presser foot can be raised by pushing the knee lifter to the right. The hand lifter is located behind the face of the machine. The presser foot may be lifted and locked into position by raising the hand lifter to its highest position.

Oscillating Type Sewing Machines

SINGER SEWING MACHINE 31-15

The 31-15 is an oscillating type sewing machine which has a recommended speed of 2,200 stitches per minute and makes a lockstitch. The 31-15 is intended for sewing clothing. It is very good for nylon cloth sewing and can be used for sewing lightweight canvas up to 8 ounces. The number of stitches can be regulated from 7 to 32 stitches per inch.

When the 31-15 machine is in operation, the balance wheel turns over toward the operator. When hand turning the balance wheel, always rotate it in this direction.

The components of the Singer Sewing Machine 31-15 are shown in figure 11-2.

Lubrication

To insure easy operation and to prevent unnecessary wear of the moving parts, all sewing machines need oiling. When a machine is in constant use, it should be oiled twice a day. A new machine should be oiled more frequently when in constant use. A castor base oil is recommended since mineral base oil tends to gum the moving parts.

Oiling points for the 31-15 machine are shown in figures 11-3, 11-4, and 11-5.

Oil should be applied regularly to the shuttle bearing in the shuttle race. Occasionally remove the faceplate and apply oil to the bearings and joints that are uncovered.

Needles and Thread

The proper needle to be used on the 31-15 Singer Sewing Machine is class and variety 16 x 87. Needles are available in various sizes and any of the following sizes may be used: 14, 16, 17, 18, 19, 21, 22, and 23. The size of thread used determines the size of needle to be used. Needles vary in size according to number, the smaller the number the smaller the needle diameter; the larger the number the larger the needle diameter. Needles do not vary in length within the same class and variety.

Orders for needles must specify the QUANTITY required, the SIZE number, and the CLASS and VARIETY number, separated by an "X."

An example of an order follows:

100 No. 18, 16 x 87 needles.

Best results will be obtained by using needles furnished by the manufacturer of the machine.

Figure 11-6 shows the six parts of a needle used in an oscillating type sewing machine.

The thread to be used on an oscillating type sewing machine is LEFT TWIST (also known as Z twist). Either right or left twist thread can be used in the bobbin, but to eliminate the possibility of mixing the machine and bobbin thread, it is advisable to order only left twist thread.

To determine the twist of thread hold the thread as shown in figure 11-7. Turn the thread toward you with the right hand; if it is left twist, the strands will wind tighter; if it is right twist, the strands will unwind.

To determine the relative sizes of needles and threads that can be used, refer to table 11-1.

Table 11-1.--Relative sizes of needles and thread.

Sizes of needles	Cotton thread size	Nylon thread size
18	24 x 4	A and B.
19	24 x 4	C.
21	24 x 4	E.
22	16 x 4	E.

Operation

The following practices and procedures will help to insure safe and smooth operation of the sewing machine.

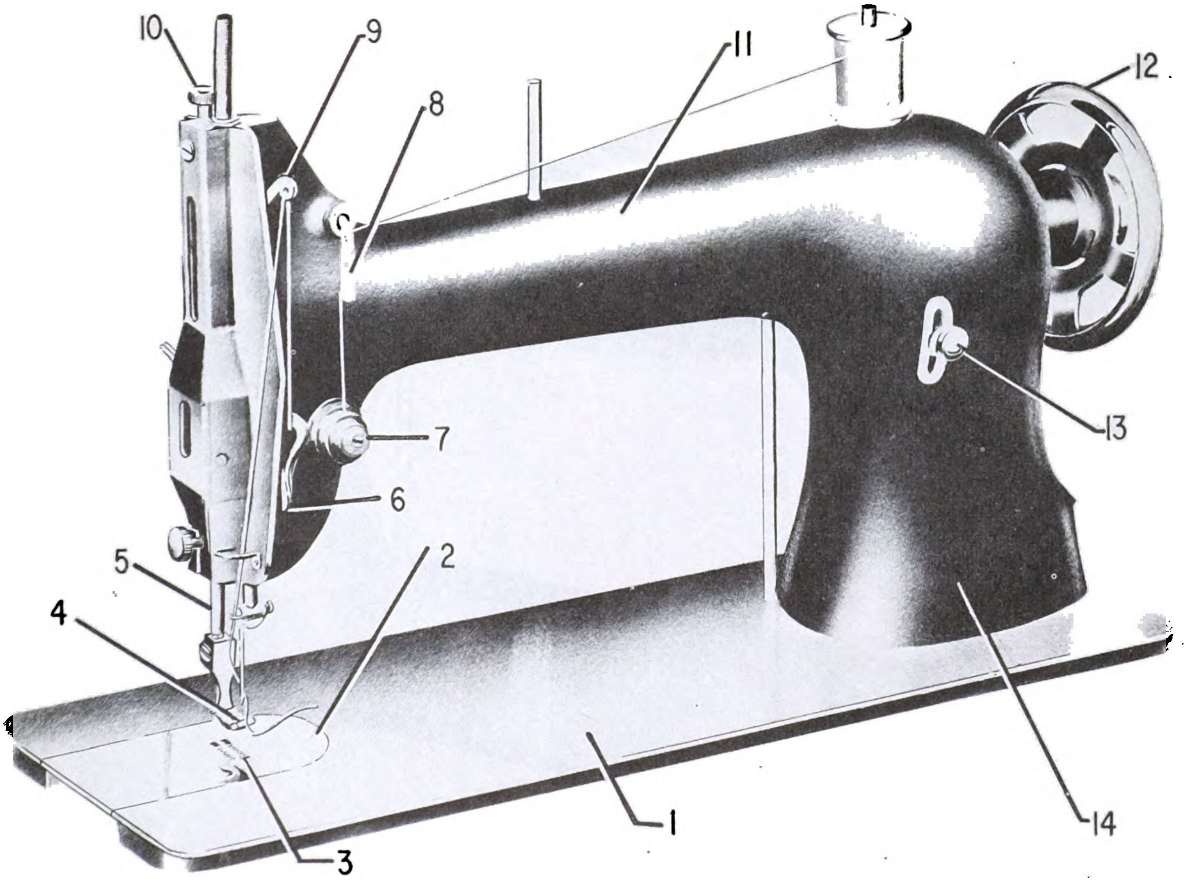


Figure 11-2.—Singer Sewing Machine 31-15.

1. Bed.
2. Throat plate.
3. Feed dog.
4. Presser foot.
5. Needle bar.
6. Face.
7. Tension regulating thumb nut.
8. Thread retainer.
9. Thread takeup lever.
10. Pressure regulating thumbscrew.
11. Arm.
12. Balance wheel.
13. Feed regulator thumbscrew.
14. Upright.

1. The balance wheel must always turn toward the operator.
2. Do not run the machine with the presser foot resting on the feed dog without material being under the presser foot.
3. Do not run the machine when both bobbin case and needle are threaded unless there is material under the presser foot.
4. Do not try to help the machine by pulling the material. You may bend or break the needle. If properly adjusted, the machine feeds the work without assistance.
5. The slide over the bobbin case should be kept closed when the machine is in operation.
6. Keep your head away from the takeup lever.
7. When running the machine do not take your eyes away from the needle and presser foot.
8. Keep your fingers from under the needle.

Setting the Needle

Turn the balance wheel toward you until the thread takeup lever moves upward to its highest point; loosen the setscrew in the needle clamp; insert the needle ALL THE WAY into the needle bar so that the long groove of the needle is toward the left, and the eye of the needle is directly in line with the arm of the machine; then retighten the setscrew. NOTE: When setting any needle, always insert it with the long thread groove toward the bobbin.

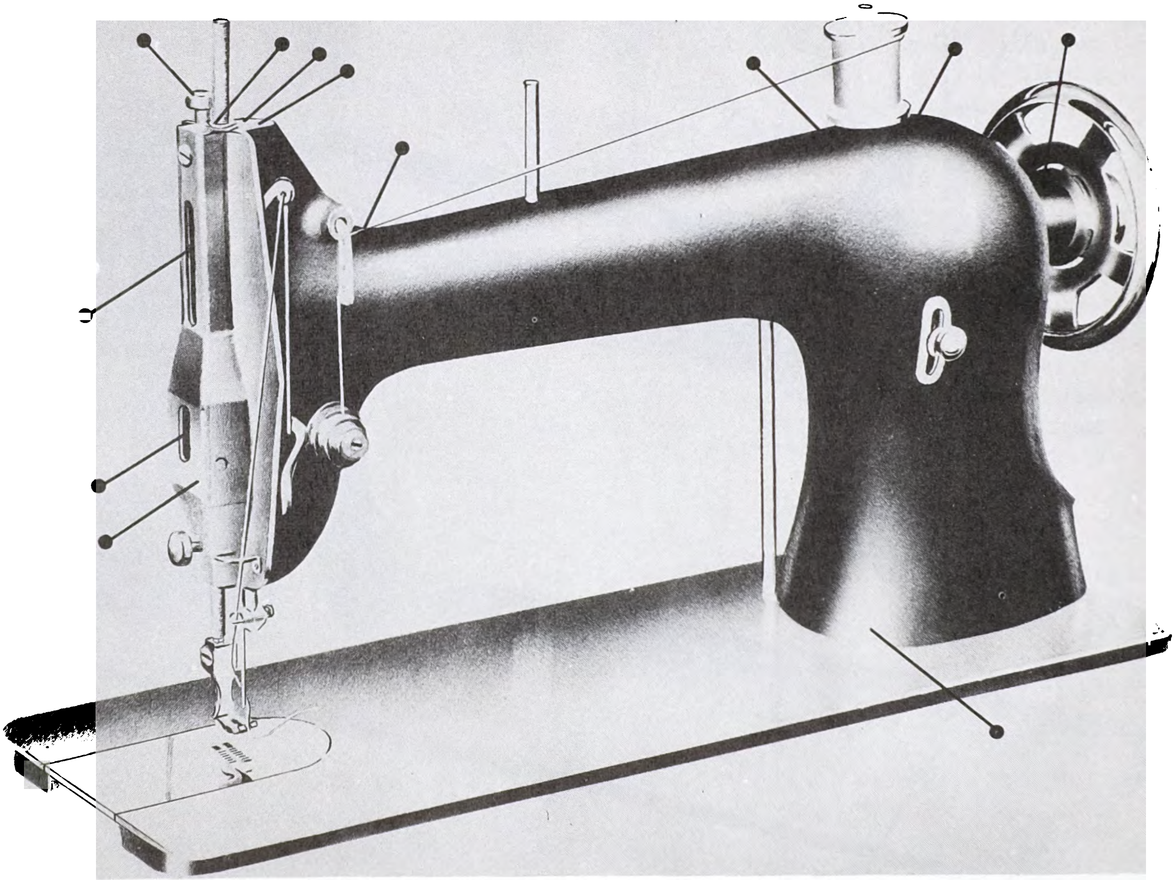


Figure 11-3.—Oiling points at the front of the machine.

Threading the Machine

Threading a sewing machine is a very simple job. The procedure may vary slightly with different models, but after working with the various machines in the loft, the task will become automatic.

The procedure for threading the 31-15 sewing machine is illustrated in figure 11-8 and described in the following paragraph.

Pass the thread from the thread stand to the thread post on top of the machine, right to left through the bottom hole, and then right to left through the top hole. Pass the thread from right to left through the top hole in the thread retainer (1). Pass the thread from left to right through the middle hole in the thread retainer (2). Pass the thread from right to left through the bottom hole in the thread retainer (3). The thread is then passed down and under from right to left between the tension discs (4). Draw the thread up into the thread take-up spring (5), drawing the thread up and beyond the spring end so that it comes out in the center of the spring. The thread is then placed under the tension thread guard (6). Pass the thread up and from right to left through the hole in the thread takeup lever (7). The thread is now drawn down through three thread guides (8), (9), and (10). Pass the thread from left to right through the eye of the needle (11). Draw about two inches of thread through the eye of the needle with which to commence sewing.

Removing the Bobbin Case

Before attempting to remove the bobbin case, turn the balance wheel toward you until the needle moves upward to its highest position.

Remove the slide in the bed of the machine for visibility, reach under the table with the left hand, and using the thumb and forefinger, open the bobbin case latch (1) figure 11-9, and lift out the bobbin case (2).

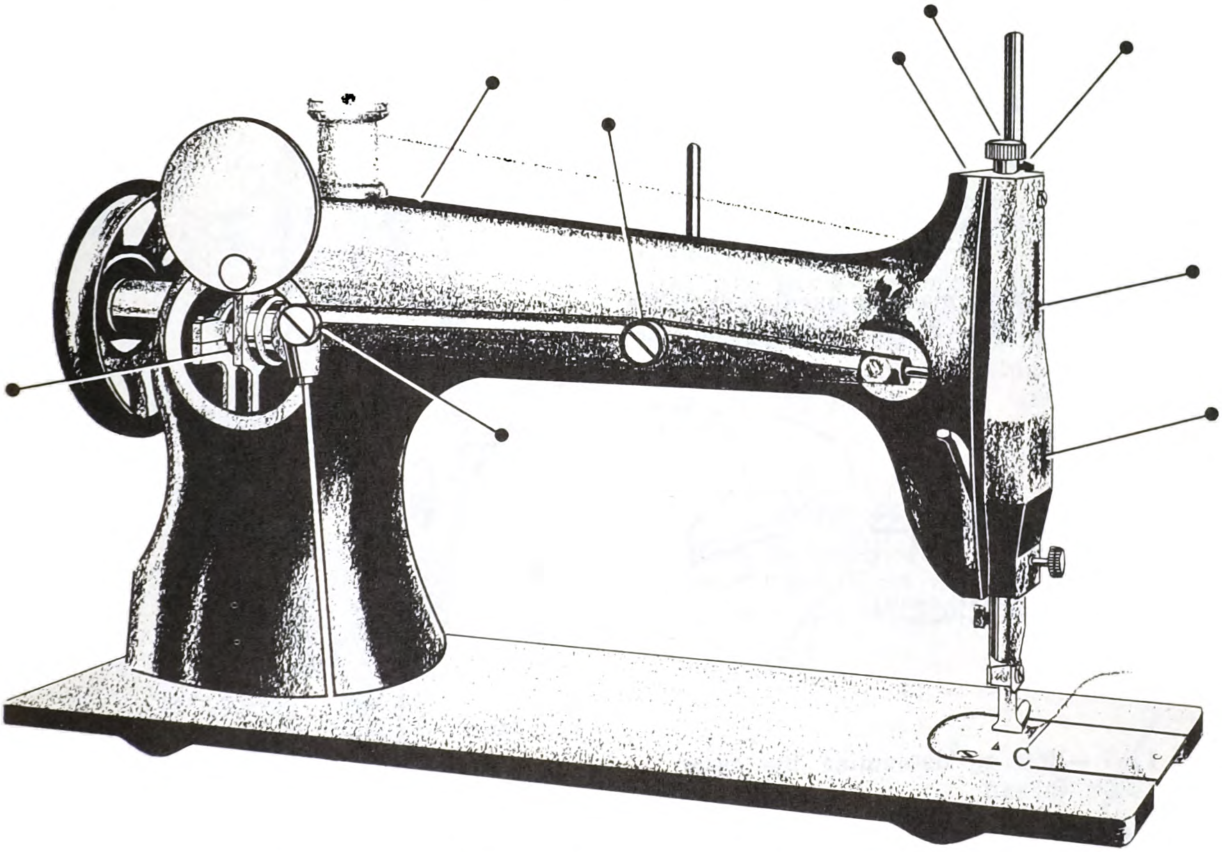


Figure 11-4.—Oiling points at the back of the machine.

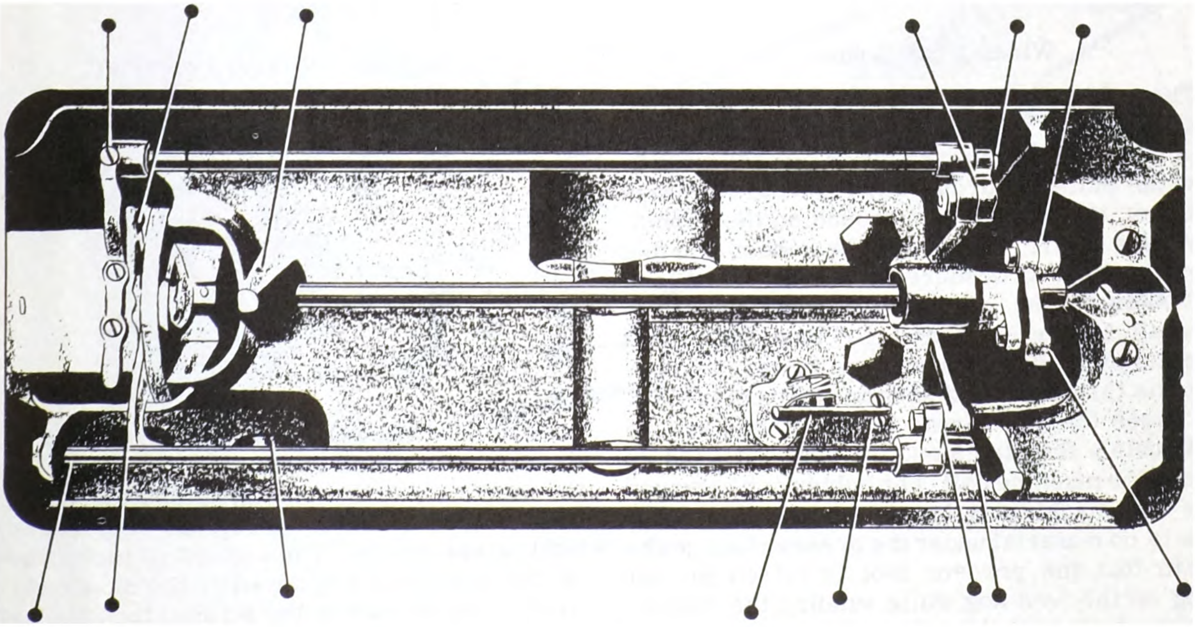


Figure 11-5.—Oiling points at the base of the machine.

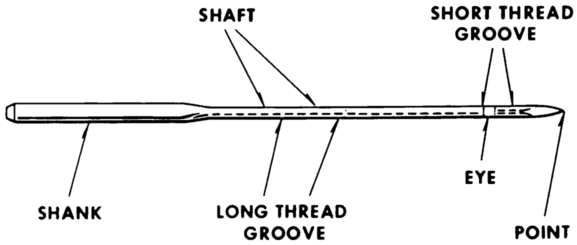


Figure 11-6.—Sewing machine needle adaptable to the 31-15 sewing machine.

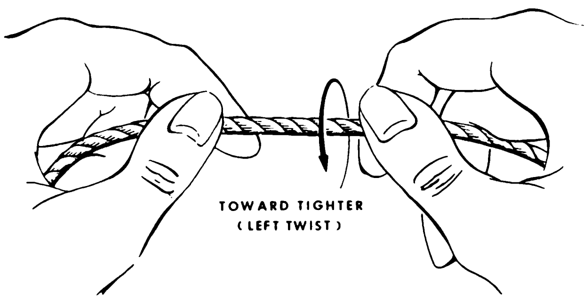


Figure 11-7.—How to determine the twist of thread.

While the latch is held open, the bobbin is retained in the bobbin case. Release the latch, turn the open end of the bobbin case down, and the bobbin will drop out.

Winding the Bobbin

The bobbin winder is fastened to the table with its driving pulley in front of the sewing machine belt. The bobbin winder is so positioned to allow the pulley to drop away from the belt when sufficient thread has been wound on the bobbin.

Figure 11-10 illustrates the bobbin-winding operation. The procedure is as follows. Place the bobbin on the bobbin winder and push it on the shaft as far as it will go. Pass the thread from the spool down through the thread guide (1). Loop the thread around back and through the tension discs (2). The thread is then wound around the bobbin a few times and the pulley pushed up against the machine belt. The bobbin can be wound while the machine is being used for sewing. If there is no material under the presser foot, make certain that the presser foot is raised and not riding on the feed dog while winding the bobbin.

When sufficient thread has been wound on the bobbin, the pulley on the bobbin winder will drop back from the machine belt automatically. If the thread does not wind evenly on the bobbin, loosen the screw (3) in the tension bracket and move the bracket to the right or left as required; then tighten the screw. The amount of thread wound on the bobbin is regulated by the screw (4). To wind more thread on the bobbin, turn the screw to the right; to wind less thread on the bobbin, turn this screw to the left.

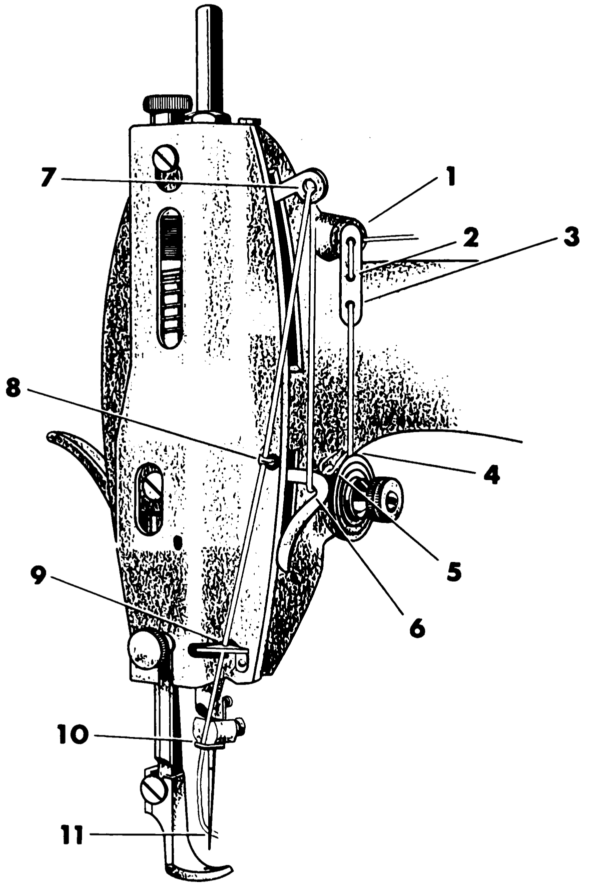


Figure 11-8.—Threading the 31-15 sewing machine.

1. Top hole of thread retainer.
2. Middle hole of thread retainer.
3. Bottom hole of thread retainer.
4. Tension discs.
5. Thread takeup spring.
6. Tension thread guard.
7. Thread takeup lever.
8. Thread guide.
9. Thread guide.
10. Thread guide.
11. Needle eye.

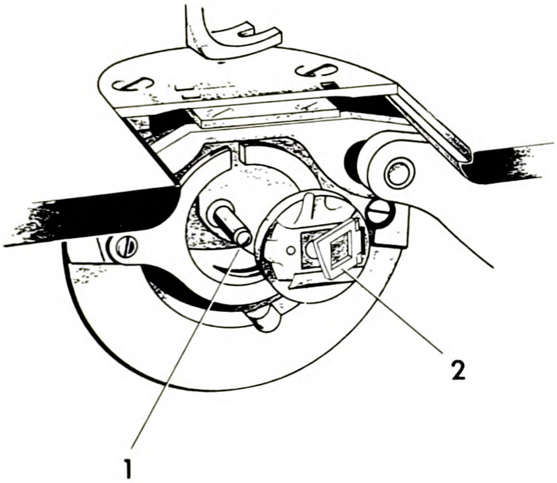


Figure 11-9.—Removing the bobbin case.

1. Bobbin case latch.
2. Bobbin case.

Threading the Bobbin Case

Hold the fully wound bobbin between the thumb and forefinger of the right hand with the thread end running over the top toward the right, as shown in figure 11-11 (A). With the left hand hold the bobbin case as shown, with the thread slot near the top.

Place the bobbin into the bobbin case and pull the thread into the slot in the edge of the bobbin case (B). Draw the thread down under the tension spring and into the delivery eye at the end of the tension spring (C). When the free end of the thread is pulled, the bobbin will rotate clockwise if the bobbin case has been threaded properly.

Replacing the Bobbin Case

Hold the latch open on the threaded bobbin case with the thumb and forefinger of the left hand, with the latch in a horizontal position.

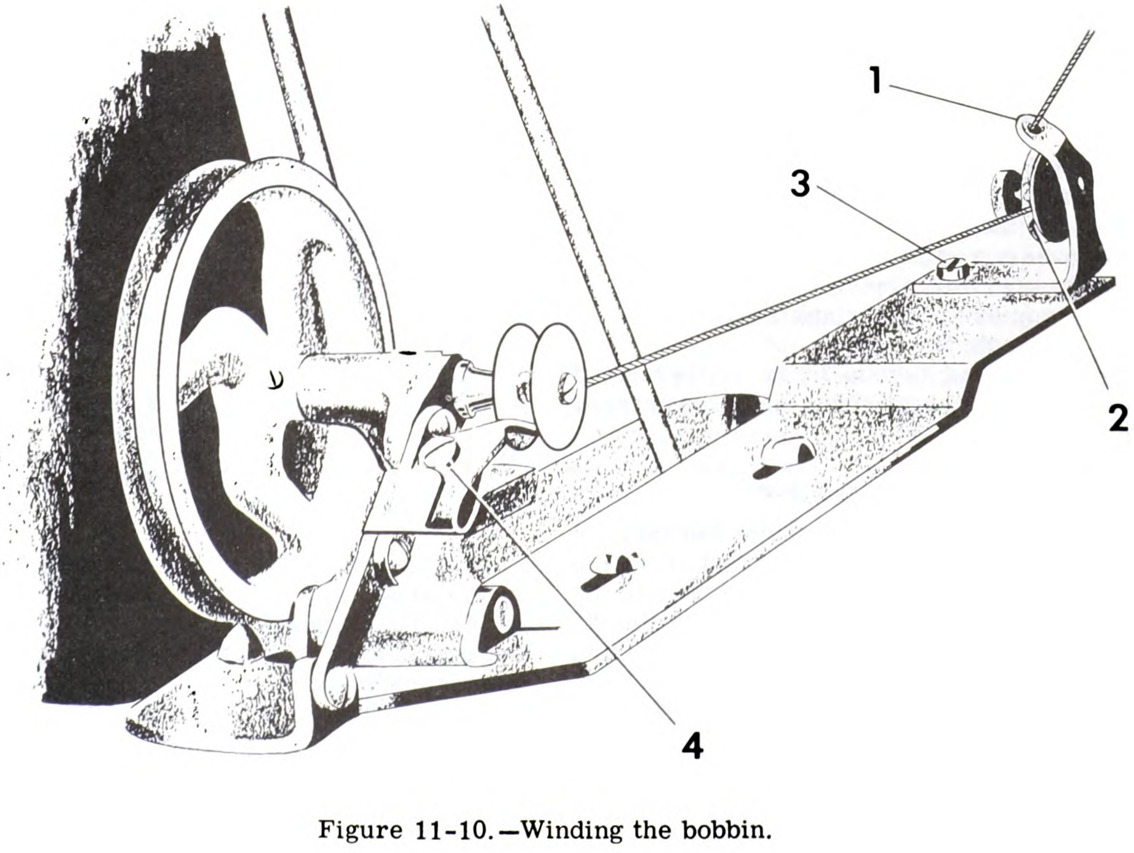


Figure 11-10.—Winding the bobbin.

1. Thread guide.
2. Tension disc.
3. Setscrew.
4. Setscrew.

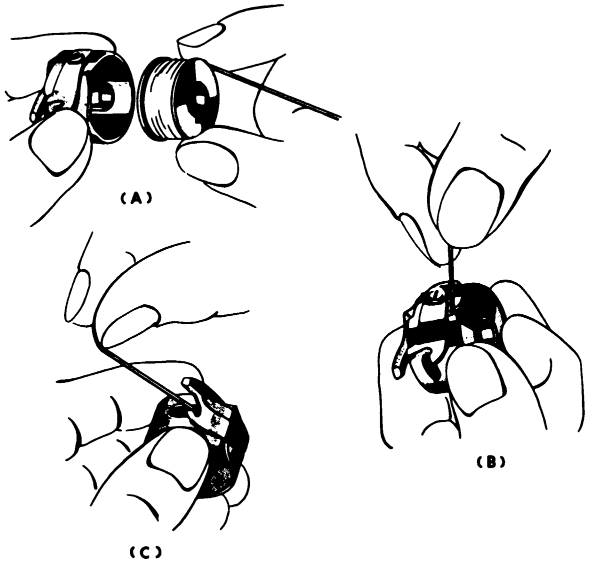


Figure 11-11.—Threading the bobbin case.

Place the bobbin case on the center stud of the shuttle body. Release the latch and press the bobbin case back until the latch catches the grove near the end of the stud.

Preparing for Sewing

With the left hand, hold the end of the needle thread, leaving it slack from the hand to the needle. Turn the balance wheel toward you until the needle moves down and catches the bobbin thread. Continue to turn the balance wheel forward until the needle comes up and brings the bobbin thread up with the needle thread.

With the thread takeup lever at its highest position, lay both threads back under the presser foot.

Commencing to Sew

Place the edge of the material beneath the presser foot, lower the presser foot, turn the balance wheel by hand until the needle is in the material, and press lightly on the treadle. To prevent fouling the needle thread in the bobbin case, hold the ends of both threads until the first few stitches are made.

While sewing, hold the work flat, but do not pull or push on the material. Let the feed dog carry the work evenly under the presser foot and needle. If the operator pulls on the material, the needle bends, strikes the throat plate, and is either dulled, or more likely, broken, When the needle is about to cross a seam or other unusually thick or uneven place in the work, disengage the clutch, and hand-turn the machine over the rough place; otherwise, the needle may be broken or thrown out of time.

Regulating the Tension

The tension on the needle thread should be regulated only when the presser foot is down. If the tension of the machine thread is not correct, it should be adjusted by turning the tension adjusting nut, as shown in figure 11-12. To INCREASE THE TENSION turn the nut clockwise; to DECREASE THE TENSION turn the nut counterclockwise.

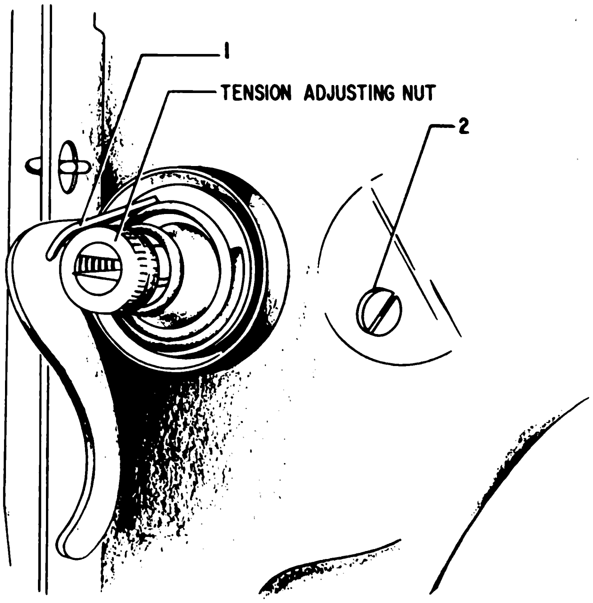


Figure 11-12.—Adjusting the machine thread tension.

1. Thread takeup spring.
2. Setscrew.

The tension on the bobbin thread is regulated by the small screw in the bobbin case tension spring. To increase the tension turn the screw clockwise; to decrease the tension turn the screw counterclockwise.

This screw is very small and is easily lost if extreme care is not exercised in backing it out when decreasing the tension. If the screw is tightened excessively or is slightly too long, it will penetrate into the inside of the bobbin case and prevent removal of the bobbin.

When the tension on the bobbin thread has once been properly adjusted for a particular size of thread, it is seldom necessary to change it.

A correct stitch can usually be obtained by varying the tension on the needle thread, which is an easier adjustment.

For ordinary stitching, the needle and bobbin threads should be locked in the center of the thickness of the material as shown in figure 11-13 (A). When adjusting the tensions, you will not have a cross section of the stitch.

If the tension on the needle thread is too tight, or if the bobbin tension is too loose, the thread will lie straight along the upper surface of the material and appear as small loops (fig. 11-13 (B)).

If the tension on the bobbin thread is too tight, or if that on the needle thread is too loose, the bobbin thread will lie straight along the underside of the material (fig. 11-13 (C)).

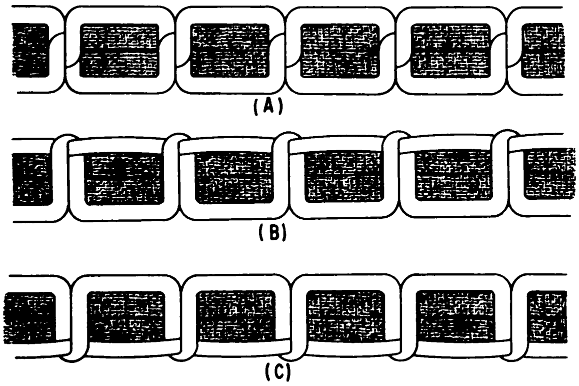


Figure 11-13.—Proper and improper adjusted tensions.

Regulating the Length of Stitch

The length of stitch can be checked at the time the tension of the stitch is checked, as a trial run of stitches is necessary during both procedures.

The length of stitch is regulated by the thumbscrew in the slot on the front of the upright of the machine. To LENGTHEN the stitch, loosen the thumbscrew and move the lever DOWN. To SHORTEN the stitch, loosen the thumbscrew and move the lever UP. When the desired length of stitch has been obtained by test running the machine on scrap material, tighten the thumbscrew.

Regulating the Pressure on the Material

Pressure on the material is regulated by the pressure regulating thumbscrew on top of the machine face. To increase the pressure, turn the thumbscrew clockwise. The pressure should be just heavy enough to enable the feed dog to move the work along evenly.

Removing the Work

Hand turn the balance wheel toward you until the thread takeup lever is at its highest position. Raise the presser foot, either by the hand lever or by the knee lift, and draw the work and threads straight behind the presser foot. Cut the threads close to the material, leaving about two free inches of bobbin and machine thread.

Adjusting the Thread Takeup Spring

The thread takeup spring (fig. 11-12) should be set so that when the eye of the needle reaches the material on the downward stroke of the needle bar, the spring will be through acting on the thread, and will rest against the stop on the thread takeup spring regulator.

If the thread takeup spring is not correctly set, loosen the setscrew (2) in the arm of the machine and turn the tension adjusting stud to the right for more movement of the spring, or to the left for less movement. When the spring is correctly set, retighten the setscrew.

The tension on the thread takeup spring should be just sufficient to take up the slack of the needle thread until the eye of the needle reaches the material on its descent. To increase the tension on the thread takeup spring, loosen the tension adjusting stud and move the takeup spring from the recess in the regulator to the right between the regulator and the tension discs. When the required tension is obtained, securely tighten the tension adjusting stud and move the spring back into its position in the regulator recess. To decrease the tension, move the spring to the left between the regulator and the tension discs.

SINGER SEWING MACHINE 7-33

The class 7-33 sewing machine is a lockstitch heavy duty machine and is intended for use in sewing heavy canvas, webbings, and other material not adaptable to the lighter duty sewing machines. The only difference between the 7-31 and the 7-33 is that the 7-33 has the clutch on the motor, while the 7-31 has the clutch on the balance wheel. The operation and maintenance techniques are identical.

As on any Singer Sewing Machine, the balance wheel of the 7-33 should always turn toward the operator.

Lubrication

The 7-33 machine is oiled at all the oiling points shown in figure 11-14 and 11-15. The machine should be oiled twice daily when it is in constant use. Use a castor base oil as recommended by the manufacturer.

Needles and Thread

The procedure for ordering needles is the same for the 7-33 machine as for the 31-15 sewing machine. Refer to table 11-2 for the relative sizes of needles and thread.

Operation

The procedure for operating the 7-33 sewing machine is the same as for the 31-15 sewing machine.

Setting the Needle

The same procedure may be followed with this machine as for the 31-15 sewing machine.

Threading the Machine (fig. 11-16)

Turn the balance wheel toward you until the thread takeup lever (7) moves up to its highest position. Pass the thread from the thread stand to the thread post, right to left through the bottom hole then right to left through the top hole. Pass the thread through the two thread guides (1) and (2). Continue the passage of thread between the retainer discs (3), down and under the tension discs (4). Pass the thread into the loop of the thread takeup spring (5), under the wire loop (6), up, and from back to front through the hole in the thread takeup lever (7). Now pass the thread down through the thread guide (8), into the slot in the vibrating presser bar (9), and on through the thread guide (10) which is located on the needle clamp. The needle is now threaded from left to right through the eye of the needle (11). After the needle is threaded, pass the thread down through the hole in the lifting presser foot (12). Draw about four inches of thread through the hole in the lifting presser foot with which to commence sewing.

Notice that the lubricating cup has been bypassed. No lubricant is used on the threads and cords used in the manufacture or repair of parachutes.

Removing the Bobbin

Turn the balance wheel forward to bring the needle bar and thread takeup lever to its lowest position. With the aid of the shuttle opening tool or a small screwdriver, insert the blade end in the slot in the spring latch beneath the shuttle cylinder (fig. 11-17). Press the latch away from the cylinder and it will swing out. The bobbin will then slide out of the shuttle cylinder.

Winding the Bobbin

Place the bobbin on the bobbin winder spindle and push it up closely against the shoulder. The small pin in the shoulder must enter the slot in the bobbin.

Pass the thread from the thread stand through the hole in the left side of the bobbin from the inside. Push the bobbin winder pulley up against the balance wheel and place the bobbin winder latch in position. Raise the presser foot and start the machine. The end of the thread should be held until a few turns are wound on the bobbin to prevent slipping. When sufficient thread has been wound on the bobbin, the bobbin winder will stop automatically.

Replacing the Bobbin and Threading the Shuttle

Take the bobbin between the thumb and forefinger of the left hand as shown in figure 11-18. The free end of the thread should be drawn off from the underside toward the right. Place the bobbin in the shuttle cylinder as far as it will go. Draw the thread into the slot in the cylinder (1) and under the tension spring into the delivery eye (2). Push the shuttle cylinder in until it is locked by the spring latch. There should be about three inches of thread hanging free from the shuttle with which to commence sewing.

Regulating the Tensions

The tension on the needle thread is regulated by the thumb nut at the front of the thread retainer discs. The tension on the thread retainer discs should be just enough to cause the tension wheel to turn when the thread is taken from the spool.

The tension on the bobbin thread is regulated by the small screw which holds the tension spring to the shuttle cylinder. To increase the tension, turn the screw clockwise. To decrease the tension, turn the screw counterclockwise.

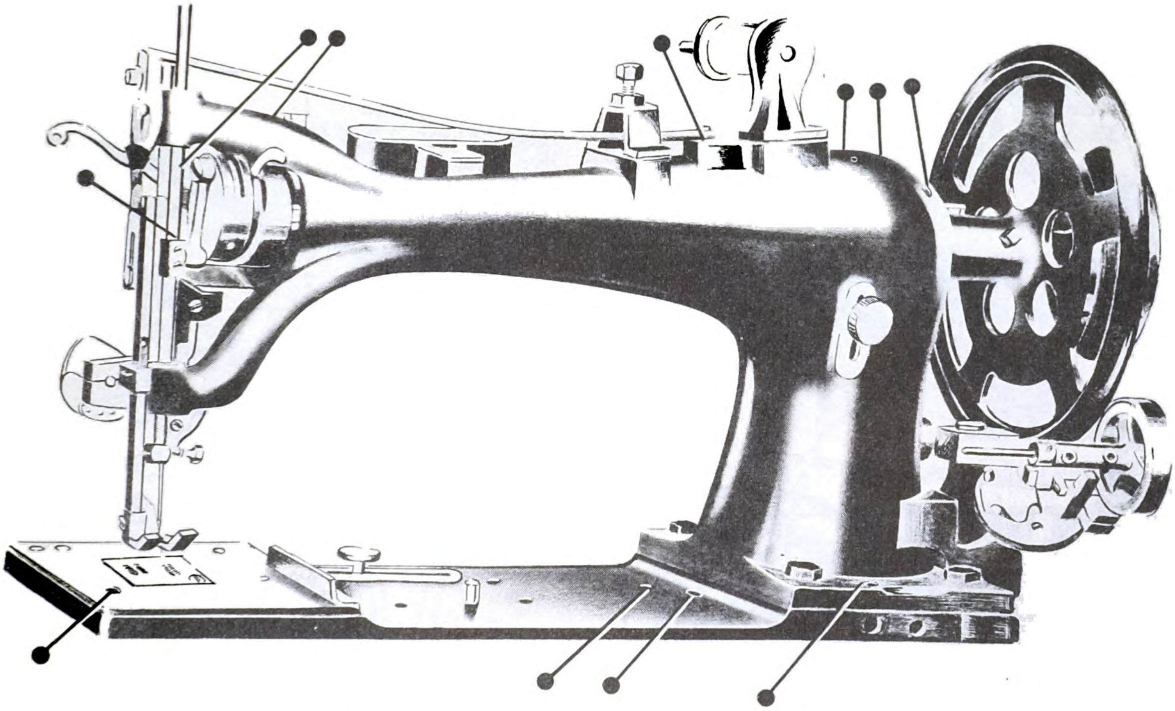


Figure 11-14.—Oiling points at the front of the 7-33 sewing machine.

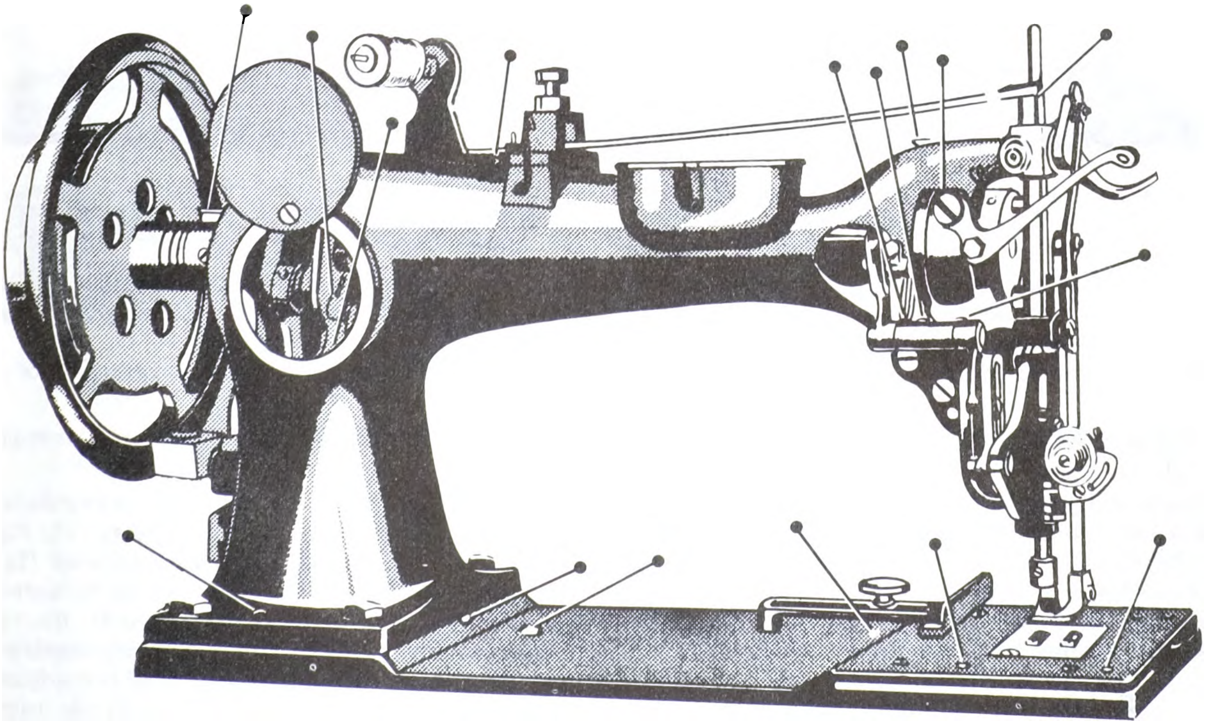


Figure 11-15.—Oiling points at the back of the 7-33 sewing machine.

Table 11-2.--Relative sizes of needles and thread.

Machine	Needle class and variety	Needle sizes	Classes of work	Needle size	Cord size
7-31 or 7-33	7 x 1	19,21,22, 23,24,25, 26, and 27.	Medium to heavy canvas.	24	3-cord
7-31 or 7-33	7 x 5	28,29,30, and 31.	Heavy canvas and webbing.	28	6-cord

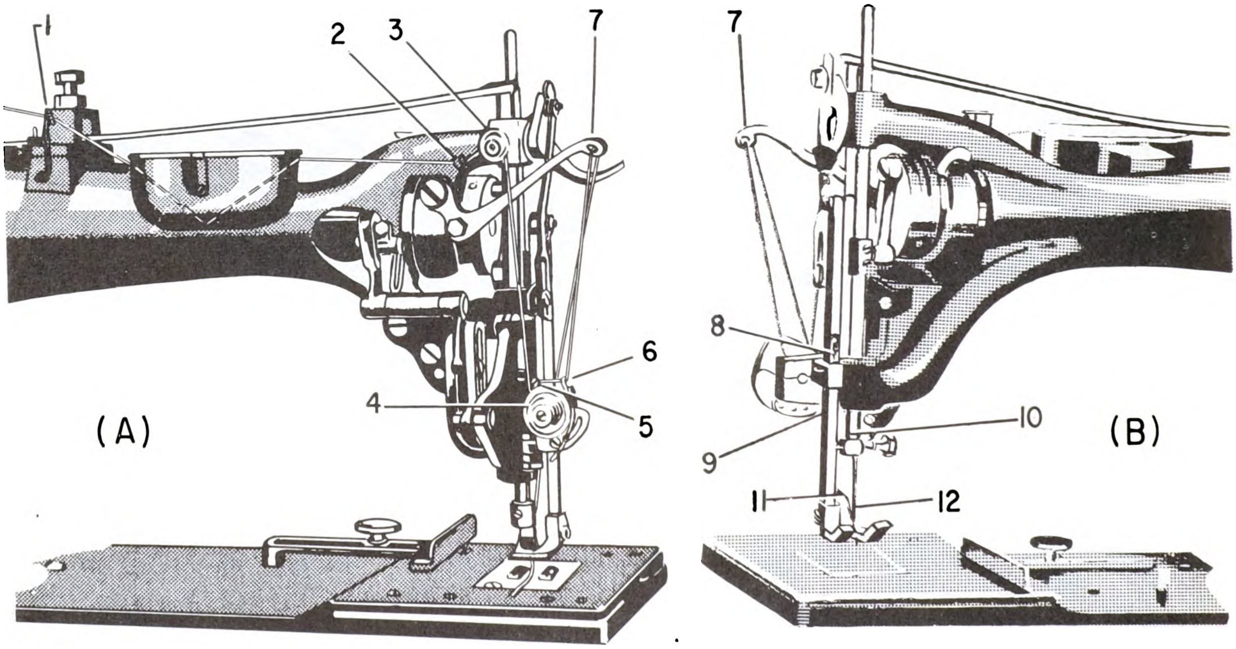


Figure 11-16.—Threading the 7-33 sewing machine.

1. Thread guide
2. Thread guide.
3. Retainer discs.
4. Tension discs.
5. Thread takeup spring.
6. Wire loop.
7. Thread takeup lever.
8. Thread guide.
9. Slot in the vibrating presser bar.
10. Thread guide on the needle clamp.
11. Eye of the needle.
12. Hole in the lifting presser foot.

The tension on the machine and bobbin threads should be checked by test running a row of stitches on scrap material. The lockstitch should lock in the center of the material as described for the 31-15. When sewing webbings with the 7-33 sewing machine, the specifications for webbing sewing should be checked to determine at what ply of the webbing the stitch should lock.

Regulating the Length of Stitch

The procedure for regulating the stitch on the 7-33 sewing machine is the same as for the 31-15.

Regulating the Pressure on the Material

The pressure on the material is regulated by means of the hexagon head screw, (1), figure 11-19. Loosen the hexagon head locknut (2) and turn the adjusting screw clockwise to increase the pressure or counterclockwise to decrease the pressure on the spring (3). When the desired pressure has been obtained, hold the adjusting screw with a wrench to keep it from turning while the locknut is being tightened against the bracket (4).

The pressure should be just heavy enough to enable the feed dog to move the work along evenly, and to prevent the work from rising with the needle.

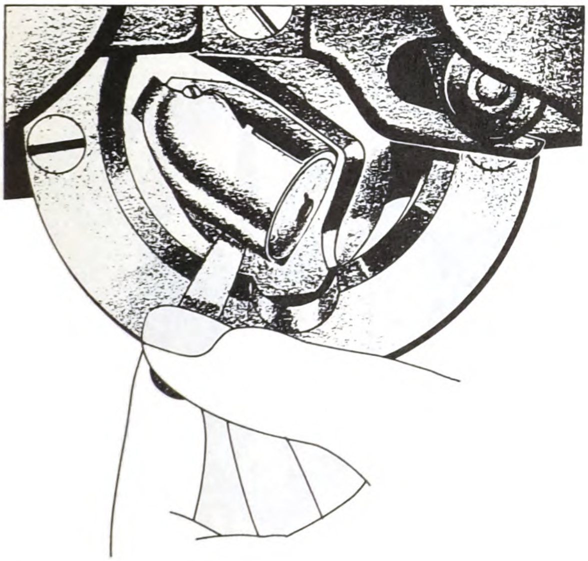


Figure 11-17.—Removing the bobbin from the shuttle cylinder.

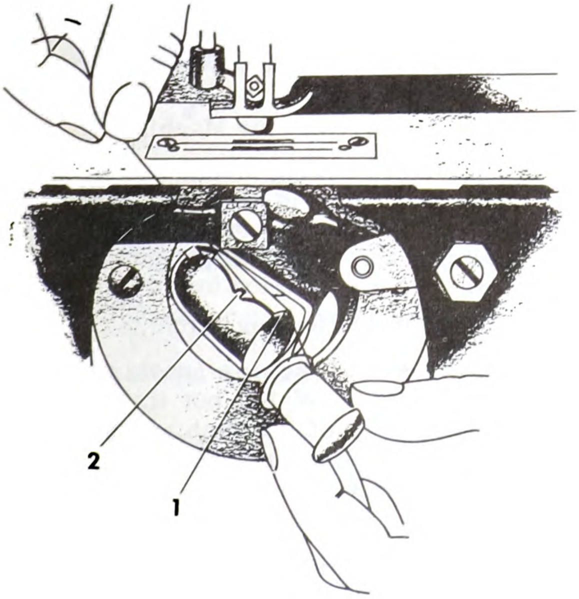


Figure 11-18.—Replacing the bobbin and threading the shuttle.

1. Thread slot in the cylinder.
2. Delivery eye and tension spring.

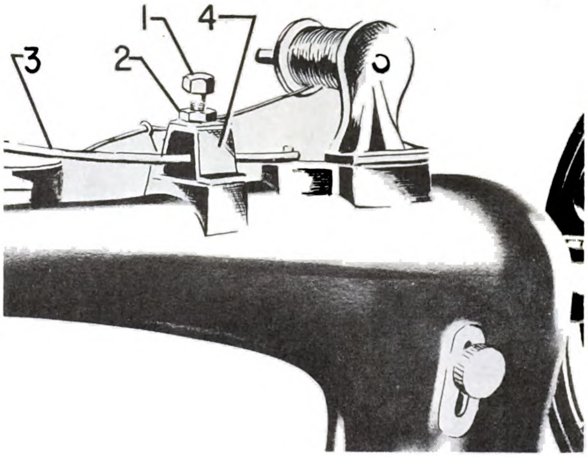


Figure 11-19.—Regulating the pressure on the material.

1. Hexagon head adjusting screw.
2. Hexagon head locknut.
3. Spring.
4. Bracket.

Preparing for Sewing

The same sewing preparatory procedures are used for the 7-33 as for the 31-15 sewing machine except there is no knee lifting device. The hand presser bar lifter is the only device provided for lifting the presser foot on the class 7-33 sewing machine.

Removing the Work

Stop the machine and raise the thread takeup lever to its highest position. Draw about three inches of thread through the thread retaining discs. Raise the presser foot and draw the work back, cutting the threads close to the material. Leave the ends of the threads under the presser foot.

Modification of Presser Foot for Webbing Sewing

The modification of a presser foot is illustrated in figure 11-20. The presser foot should be cut along the dotted line, removing the right portion of the foot. After cutting, the edges should be filed down to a smooth round finish.

Parachute harness and webbing sewing is classified as a major repair. However, there are various other sewing projects requiring webbing sewing, such as slings, bridles for tow targets, and nylon barrier repairs.

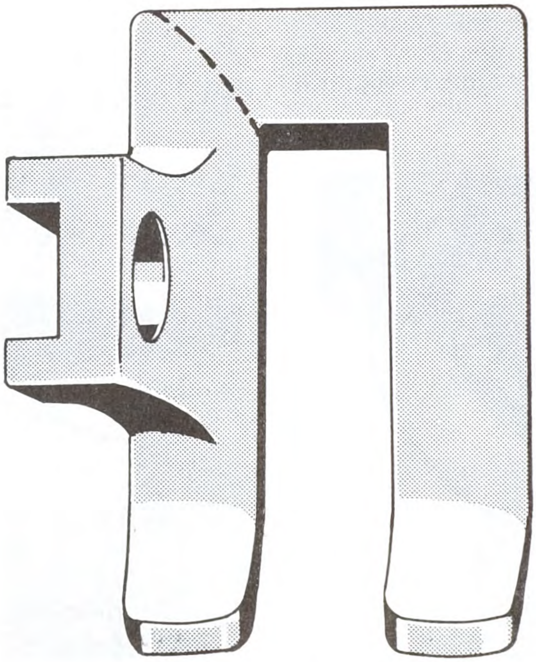


Figure 11-20.—Modification or presser foot for webbing sewing.

Rotary Type Sewing Machines

SINGER SEWING MACHINES CLASS 111

111 W 150 Sewing Machine

The 11 W 150 sewing machine is a high-speed, single-needle, lockstitch, compound feed machine employing a belt driven rotary hook with a vertical axis. It is designed for sewing medium weight fabrics such as flight clothing, nylon, twills, and light weight canvas.

111 W 151 Sewing Machine

The 111 W 151 sewing machine is also a single-needle, lockstitch, rotary hook machine, intended for high-speed straight stitching of medium-heavy materials.

The 111 W 151 sewing machine differs from other models of the class 111 machines in that it has a single presser foot instead of the alternating presser foot.

111 W 152 Sewing Machine

The 111 W 152 sewing machine is a single-needle, lockstitch, compound feed machine with a vertical axis sewing hook. This machine has alternating pressers with a 3/8 inch lift. It has a safety clutch which prevents the hook from being damaged or getting out of time due to accidental strain.

111 W 153 Sewing Machine

The 111 W 153 sewing machine is similar to the 111 W 152, but it is used for sewing heavy work such as automobile and truck upholstery, tents, awnings, and leather flight jackets.

111 W 154 Sewing Machine

The 111 W 154 sewing machine is also similar to the 111 W 152 but its alternating pressers have a lift of 1/2-inch and the machine is designed for stitching upholstery work and leather coats and binding heavy materials such as felt padding.

111 W 155 Sewing Machine

The 111 W 155 sewing machine is similar to the 111 W 154 except that its maximum stitch length is 3 1/2 to the inch, and it has an adjustable lifting eccentric for instantly setting the alternating pressers to the minimum amount of lift required for the work to be sewn.

Lubrication of the Class 111 Sewing Machines

Figures 11-21 through 11-24 show the various lubrication points on class 111 sewing machine. Oiling points are indicated by the unnumbered arrows. Familiarization with the nomenclature of the machines may also be accomplished by studying these illustrations.

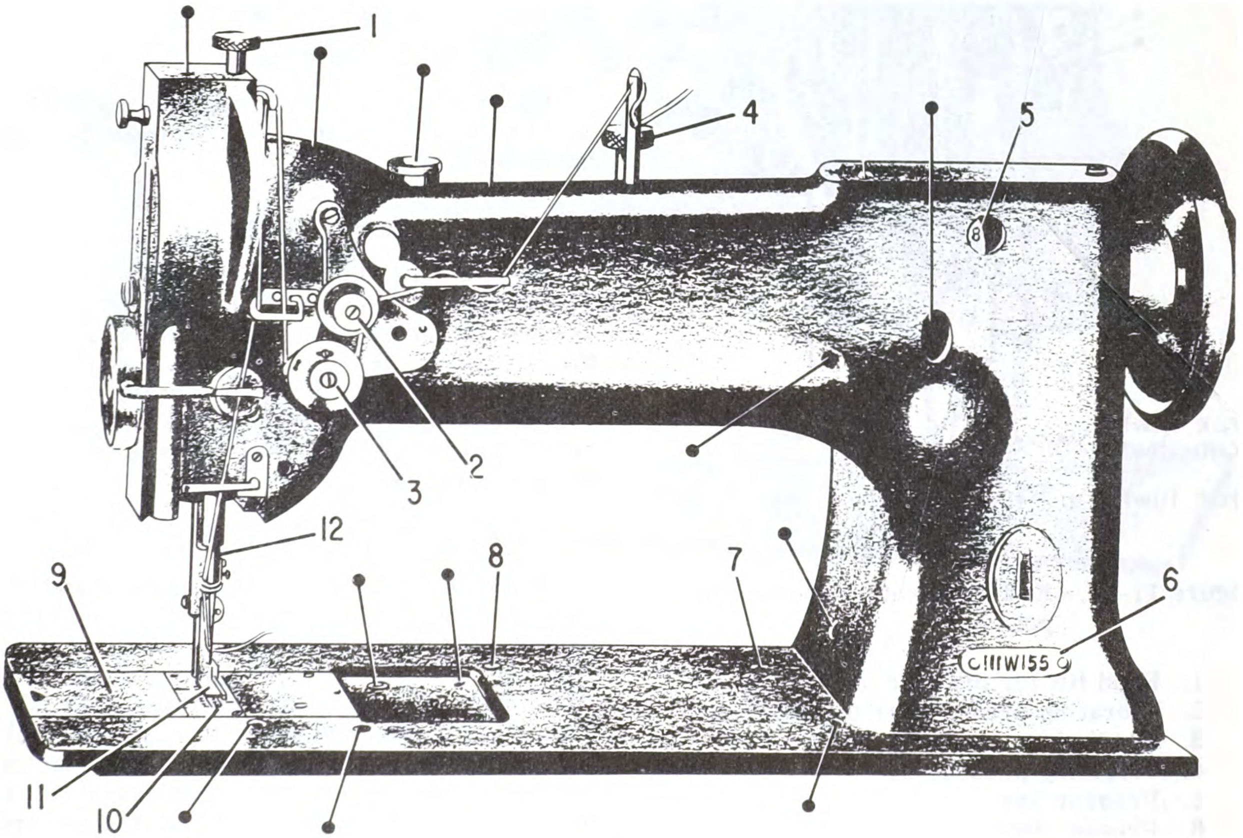


Figure 11-21.—Front of machine, showing oiling points.

1. Vibrating presser bar thumbscrew.
2. Tension thumb nut.
3. Thread controller stud thumb nut.
4. Presser bar spring regulating screw.
5. Stitch indicator disc view hole.
6. Model number.
7. Hook driving shaft lock stud.
8. Feed regulating stud (plunger).
9. Bed slide.
10. Throat plate.
11. Presser foot.
12. Needle bar.

To lubricate the class 111 machine, swing back the top cover and oil the bearings, then replace the cover.

Loosen the thumbscrew in the upper end of the faceplate, turn the faceplate upward, and oil the wick and bearings as shown in figure 11-22. After oiling, turn down the faceplate and tighten the thumbscrew.

Turn the machine back on its hinges and apply oil at the places designated by the arrows in figure 11-24. All contacting parts on the bottomside of the machine should also be oiled.

To lubricate the hook, remove the bed slide and place oil in the oil well (fig. 11-23). This will lubricate the upper hook bearing and the mechanical opener mechanism.

The small green felt pad on the side of the bobbin case should be kept wet with oil to lubricate the hook race. When this pad is wet, it appears nearly black and when it appears light green, it indicates that it is dry. When a machine is new, oil should be applied to this felt pad EACH TIME A BOBBIN IS REPLACED.

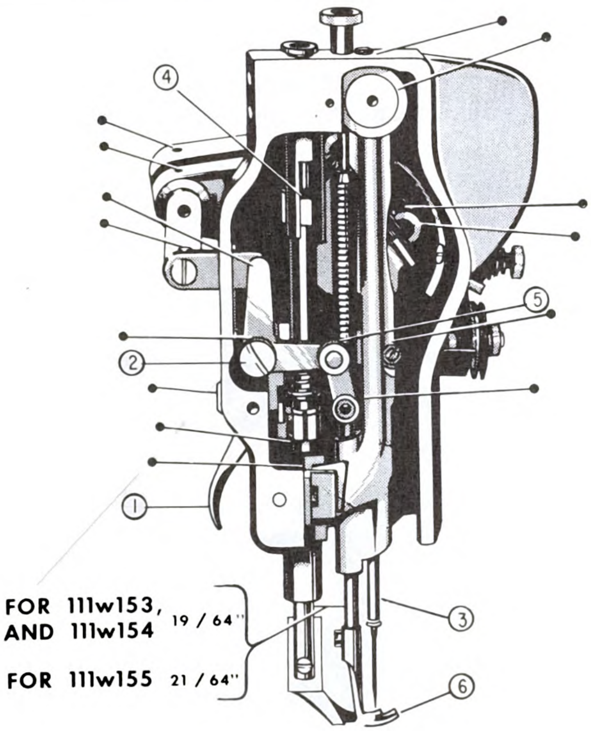


Figure 11-22.—End of machine, showing oiling points.

1. Hand lift for presser foot.
2. Vibrating presser bar thumbscrew.
3. Needle bar.
4. Vibrating presser bar.
5. Presser bar.
6. Presser foot.

Needles and Thread

The thread used on rotary type sewing machines is left twist. To determine the twist of thread, refer to figure 11-6.

Table 11-3 lists the class and variety of needle and the needle size range for each of the class 111 machines.

The size of needle to be used is determined by the size of the thread used. The thread must pass freely through the eye of the needle. If rough or uneven thread is used, or if it passes with difficulty through the eye of the needle, the machine will not function properly.

Needles used on rotary type sewing machines are ordered the same way as those for oscillating type sewing machines.

The needles for the rotary type sewing machines have 7 parts. This is one more part than the needles for the oscillating machines. The additional part is the SCARF, which is a small indention just above the short thread groove. The purpose of the scarf is to let the point of the sewing hook just close enough to the needle without striking it and allowing it to pick up the needle thread.

Operation

Operation of the rotary type sewing machines is the same as for the oscillating sewing machines.

Setting the Needle

Turn the balance wheel toward you until the needle bar moves up to its highest position. Loosen the setscrew in the needle bar and slip the needle up into the bar as far as it will go. The needle must be inserted with its long thread groove toward the left; the eye of the needle being directly in line with the machine bed. Retighten the setscrew.

Threading the Machine (fig. 11-25)

Pass the thread from the thread stand from back to front through the lower hole (1) in the thread post on top of the machine, then from right to left through the upper hole (2) in the post. Pass the thread down through hole (3), up through hole (4), and down through hole (5) in the thread guide on the front of the machine. Continue the thread over from right to left between the tension discs (6), and down, from right to left around the thread controller (7). Then the thread should go up into the fork (8) in the thread controller disc against the pressure of the wire controller. The thread is then passed up through the thread guide (9), and from right to left through the hole in the thread takeup lever (10). Pass the thread down through the thread guide (11), and between the felt pad and the felt pad retainer finger (12). (If the machine you are threading does not have the felt pad and retainer finger installed, bypass this component.) Finish the threading by passing the thread down through the thread guide (13), through the thread guide (14) at the bottom of the needle bar, and from left to right through the eye of the needle (15). Always thread a needle toward the bobbin.

Removing the Bobbin

To remove the bobbin draw out the slide plate in the bed of the machine. Insert the

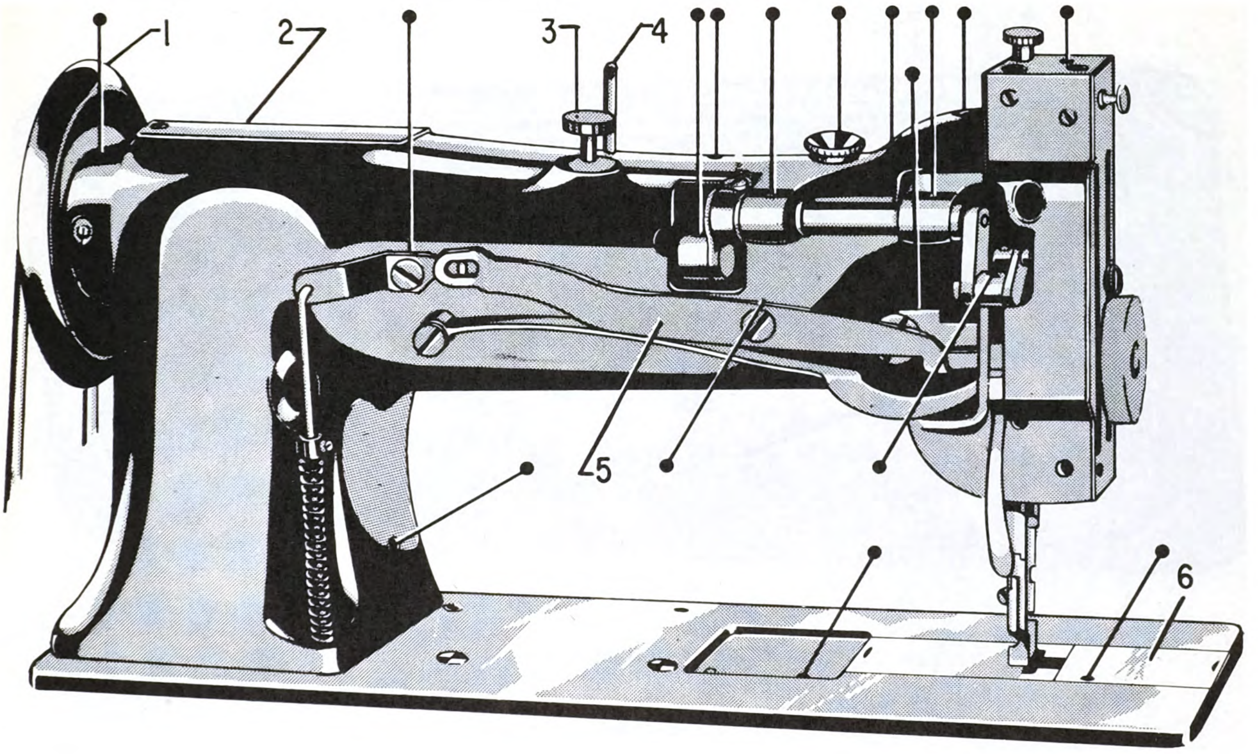


Figure 11-23.—Rear of machine, showing oiling points.

1. Balance wheel.
2. Top cover.
3. Presser bar spring regulating screw.
4. Thread post.
5. Knee lift linkage.
6. Bed slide.

fingernail of the forefinger under the latch, raise the latch, and lift the bobbin out. (See fig. 11-26.)

Winding the Bobbin

To wind the bobbin and adjust the bobbin winder, follow the procedure given for the 31-15 sewing machine.

Replacing the Bobbin and Threading the Bobbin Case

Hold the bobbin between the thumb and forefinger of the right hand with the thread drawing out on the bottom from left to right. Place the bobbin on the center stud of the bobbin case, then push down the latch.

Draw the thread into the slot (1), and under the back of the projection (2). Leave a loose end of thread about two inches long above the side. When closing the slide plate, leave just enough space for the thread to pass through when it is first picked up by the needle.

Regulating the Tensions

The tension on the needle thread is regulated by the tension thumb nut located at the front of the tension discs on the front of the machine. To increase the tension, turn this thumb nut clockwise. To decrease the tension, turn the thumb nut counterclockwise.

The tension on the bottom (bobbin) thread is regulated by means of the small screw nearest the center of the tension spring on the outside of the bobbin case, as shown in figure 11-26. To increase the tension, turn this screw clockwise. To decrease the tension, turn the screw counterclockwise.

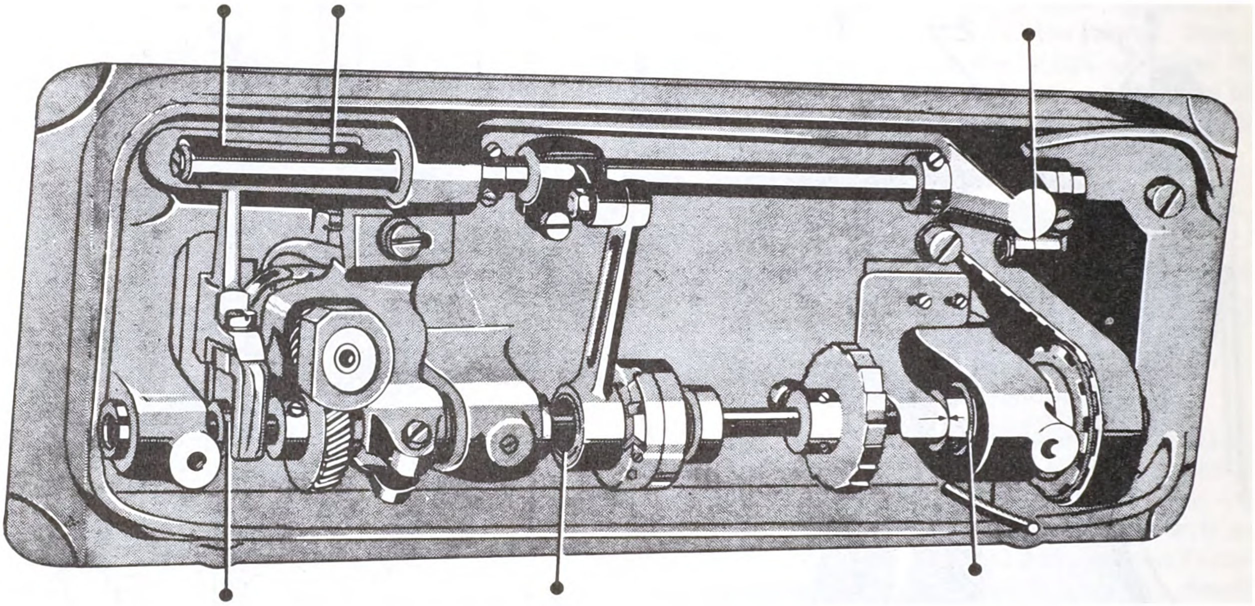


Figure 11-24.—Base of machine, showing oiling points.

Table 11-3.--Data for class 111 sewing machines.

Sewing Machine	Stitches per minute	Stitches per inch	Needle class and variety	Needle size range
111 W 150 . . .	3,500	5 to 32	135 x 7	7 to 24
111 W 151 . . .	3,500	5 to 32	135 x 17	14 to 26
111 W 152 . . .	2,900	5 to 32	135 x 17	12 to 24
111 W 153 . . .	2,900	5 to 32	135 x 17	12 to 24
111 W 154 . . .	2,900	5 to 32	126 x 11	22 to 27
111 W 155 . . .	3,500	3 1/2 to 32	135 x 17	12 to 24

Regulating the Length of Stitch

The number of stitches per inch is stamped on the stitch indicating disc which can be seen through the hole on the uprise.

To change the length of stitch, press down the feed regulating stud (plunger), located in the bed of the machine. At the same time turn the balance wheel slowly until the plunger enters a notch in the adjustable feed eccentric cam. Continue to hold the plunger and turn the balance wheel forward or backward until the number of stitches per inch desired can be seen through the hole in the front of the uprise. Disengage the plunger by releasing it.

Regulating the Pressure on the Material

The pressure on the material is regulated by the presser bar regulating screw at the back of the sewing machine. The screw acts on a flat spring. To increase the pressure, turn this screw downward. To decrease the pressure, turn this screw upward. The pressure should be only heavy enough to enable the feed to move evenly along whatever thickness of material you are using.

Preparing for Sewing

With the left hand, hold the end of the needle (machine) thread, leaving it slack from the hand to the needle. Turn the balance wheel over

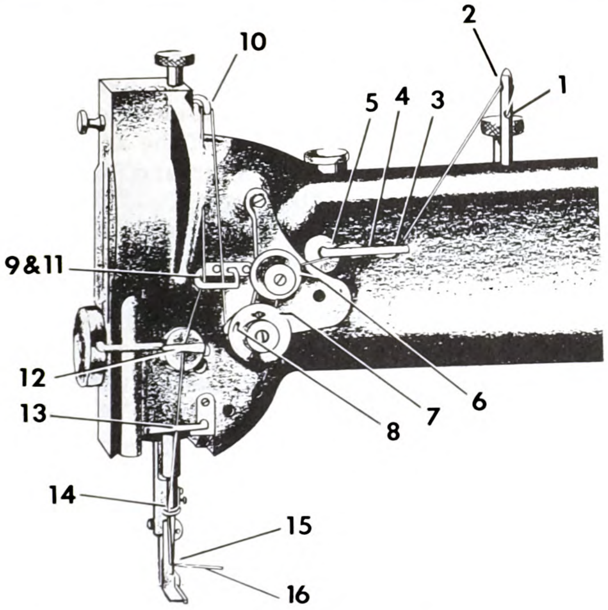


Figure 11-25.—Threading the class 111 sewing machines.

1. Lower hole in thread post.
2. Upper hole in thread post.
3. Hole in thread guide.
4. Hole in thread guide.
5. Hole in thread guide.
6. Tension discs.
7. Thread controller.
8. Fork in the thread controller.
9. Thread guide.
10. Thread takeup lever.
11. Thread guide.
12. Felt pad and retainer finger.
13. Thread guide.
14. Thread guide.
15. Eye of needle.
16. Free end of thread.

toward you until the needle moves down and up again to its highest position. If the sewing machine is properly timed, this will bring the bobbin thread up with the machine thread through the hole in the feed dog. Lay the threads back under the presser foot and close the slide.

Place the material under the presser foot. Lower the presser foot either by hand or by the knee lift, and commence to sew. Start the sewing by turning the balance wheel over toward you as you depress the treadle.

Removing the Work

After the machine has stopped, move the thread takeup lever to its highest position. Raise the presser foot, draw the work back, and cut the threads close to the material. Lay the ends of the threads back under the presser foot.

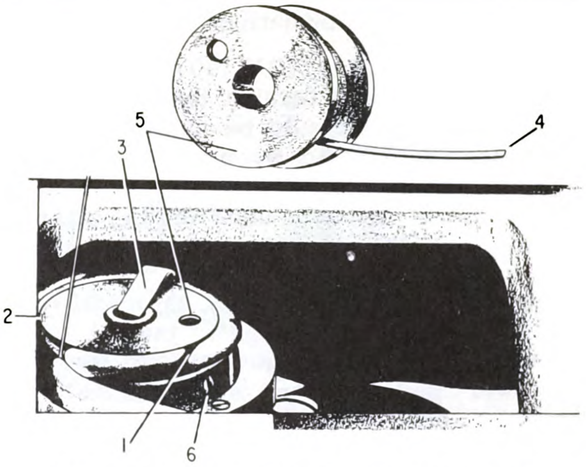


Figure 11-26.—Bobbin case threaded.

1. Slot in the bobbin case.
2. Projection on the bobbin case.
3. Bobbin case latch.
4. End of bobbin thread.
5. Bobbin.
6. Tension adjusting setscrew.

SINGER SEWING MACHINE 112 W 140

The 112 W 140 sewing machine has two needles, two belt-driven rotary sewing hooks, and makes the lockstitch. It has a compound feeding mechanism, consisting of needle and drop feed. This machine is designed for stitching flight suits, coats, and other light and medium weight fabrics requiring a compound feed.

For bulky work such as tents, awning, etc., which require two simultaneous parallel rows of lockstitching, the 112 W 116, equipped with a puller feed, is recommended.

Needles for machine 112 W 140 are of class and variety 135 x 7 and are made in sizes from 12 to 24.

When the machine is new, it should not be driven at a speed exceeding 3,000 stitches per minute. After the first few days, the machine may be driven at its recommended maximum speed of 3,500 stitches per minute. This speed depends on the nature of the work and the ability of the operator.

Lubrication

All the parts of the 112 W 140 sewing machine can be oiled without turning the machine back on its hinges. Oil should be applied to each of the places designated by arrows in figures 11-27, 28, and 29.

The type of oil to be used and the intervals of oiling are the same as given for the 111 series sewing machines.

The hook is lubricated as shown in figure 11-30. Oil should be placed in the oil well as indicated. The oil will flow to both the upper and lower bearings and also lubricate the mechanical opener mechanism.

The small green felt pads on the side of each bobbin case should be kept wet with oil to lubricate the hook races. When these pads are wet they appear nearly black, and when they appear light green, it indicates they are dry. When a machine is new, oil should be applied to these felt pads each time a bobbin is replaced.

Setting the Needles

Turn the balance wheel over toward you until the needle bars and the thread takeup lever moves to its highest position. Loosen the setscrew in the needle holders and slip the needles up into the holder as far as they will go. Make sure the inside needle (one nearest the upright part of the arm) has its long thread groove toward the left. The outside needle (one farthest from the upright part of the arm) must have its long thread groove toward the right. The eyes of both needles must be directly in line with the machine bed. After aligning the needles, tighten the setscrews.

Replacing the Bobbins and Threading the Bobbin Cases

The removal and winding of the bobbins is accomplished the same as for the 111 sewing machines. Both bobbins should be wound and replaced at the same time.

The following instructions apply to both of the bobbin cases.

Hold the bobbin between the thumb and forefinger of the right hand, the thread drawing on the bottom from left to right. Place the bobbin on the center stud of the bobbin case then push down the latch, as shown in figure 11-31.

Draw each thread into the slot (1) located in the edge of the bobbin case, and back of the projection (2). Leave a loose end of each thread about two inches long above the slide. When closing the slides, leave just enough space for

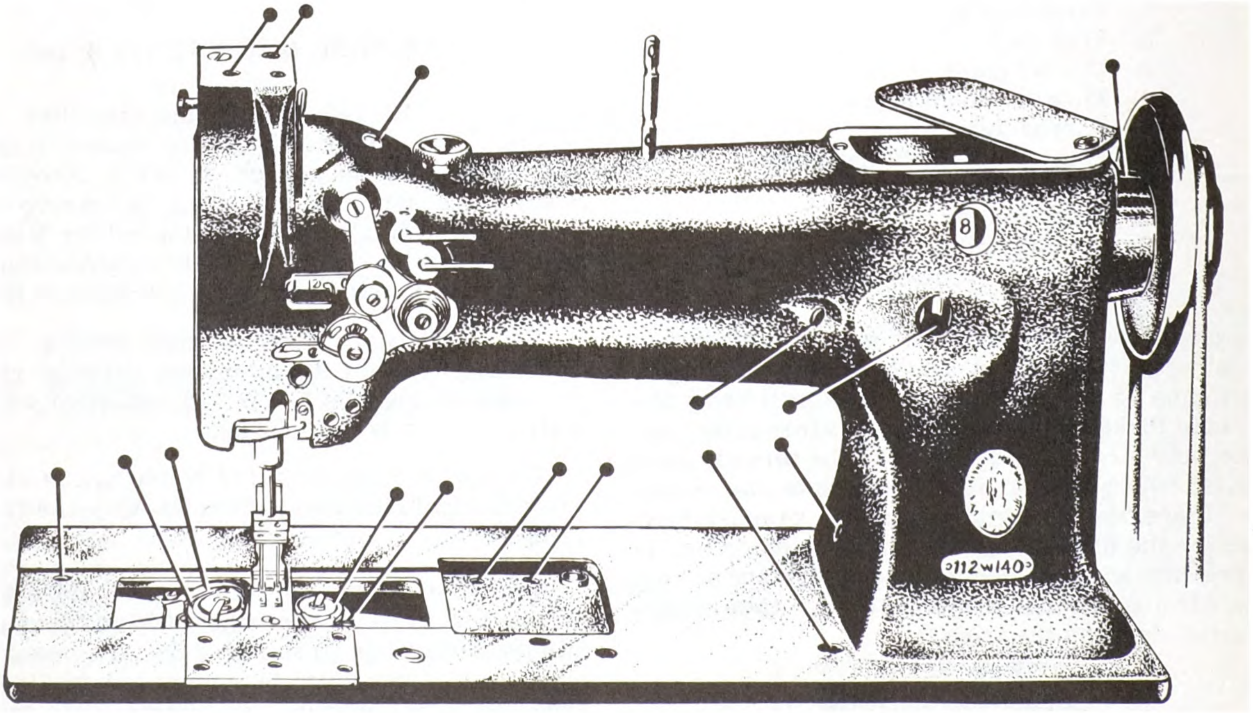


Figure 11-27.—Oiling points at the front of the machine.

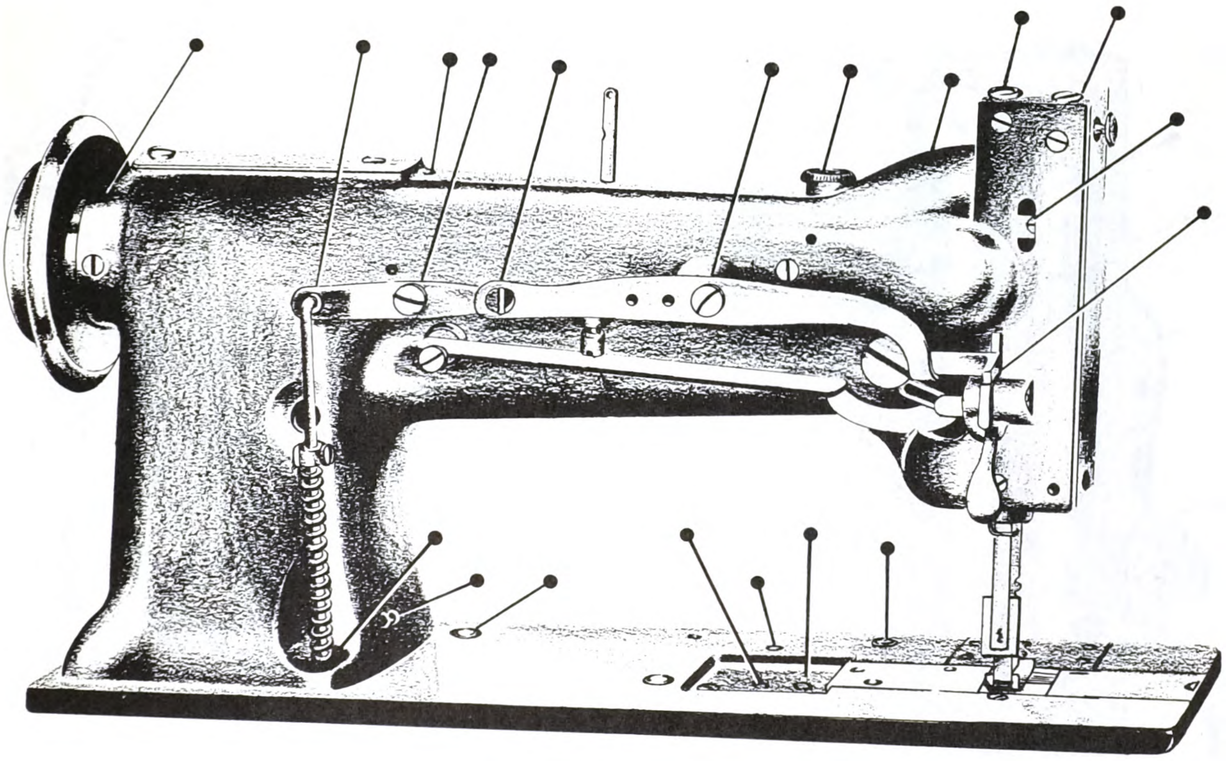


Figure 11-28.—Oiling points at the back of the machine.

the threads to pass through when being picked up by the machine threads.

Threading the Machine

The 112 W 140 sewing machine is threaded in practically the same way as the 111 series machines. The only exception is that there are two upper thread guides and two tension discs, as shown in figure 11-32. With the exception of the upper thread guides and tension discs, the two threads run parallel. Each needle is threaded from inboard to outboard (always toward the bobbin).

After the machine has been threaded, the preparation for sewing and removal of the work are the same as for the 111 series machines.

Adjusting the tensions, regulating the length of stitch and regulating the pressure on the material are also accomplished the same as for the 111 sewing machines.

SINGER SEWING MACHINE 143 W 2 AND 3

The zigzag sewing machine is an excellent sewing machine for the manufacture of parachutes. This type of machine is not as common as those previously described, but it has unlimited uses in the repair and maintenance of parachutes and survival equipment and will be found in many parachute lofts.

The 143 W 2 is a high-speed sewing machine which has an aluminum alloy vibrating needle bar frame and a rotary hook. It is intended for overseaming and zigzag stitching on fine and general fabrics and lightweight leather. It has ball bearings on the rear end of the arm shaft and hook driving shaft. The needle bar has a maximum throw of 3/16 inch, vibrating both sides of a centerline.

The 143 W 3 sewing machine is similar to the 143 W 2 except that the needle has a maximum throw of 5/16 inch.

The maximum speed recommended for machine 143 W 2 is 3,500 stitches per minute, and for machine 143 W 3, 3,000 stitches per minute, the speeds depending on the material being sewn.

Lubrication

Lubrication points for these machines are indicated by arrows in figures 11-33 through 11-36. When in continuous use, they should be oiled twice a day.

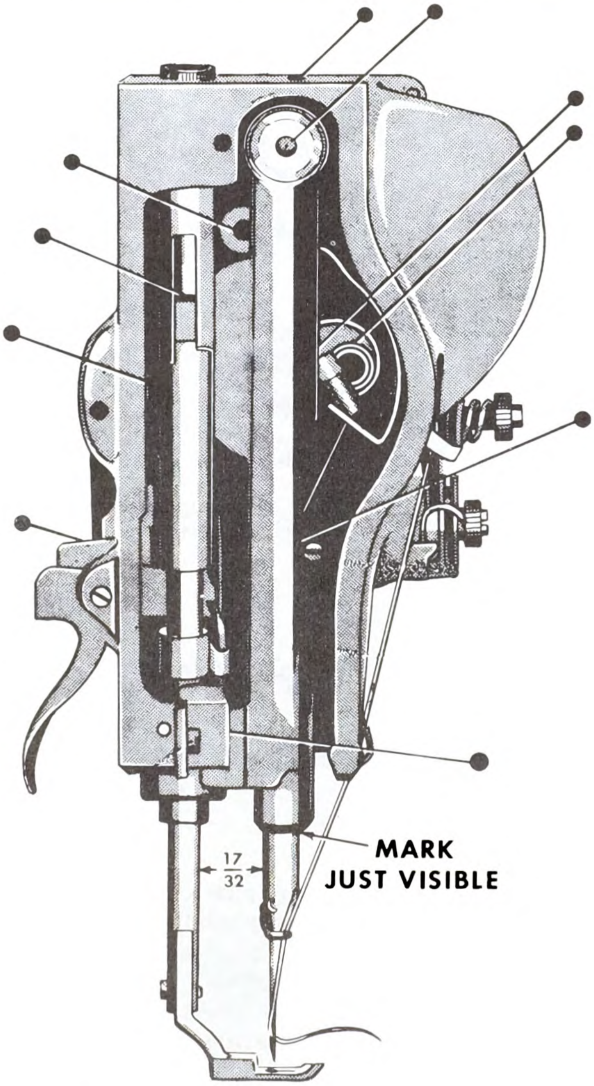


Figure 11-29.—Oiling points at the end of the machine.

Needles and Thread

The needles for the 143 W 2 and 3 sewing machine are of class and variety 135 x 7. The sizes are from 7 to 24.

Left twist thread should be used on these machines. To make a smooth even stitch with the sewing machine, use good, firmly twisted and smoothly finished thread. The thread should pass freely through the eye of the needle.

Setting the Needle

Push the needle up in the needle bar as far as it will go, with the LONG THREAD GROOVE TO THE FRONT, and secure it firmly with the setscrew. It may be necessary to turn the needle slightly to the right or left for some threads if stitches are missed.

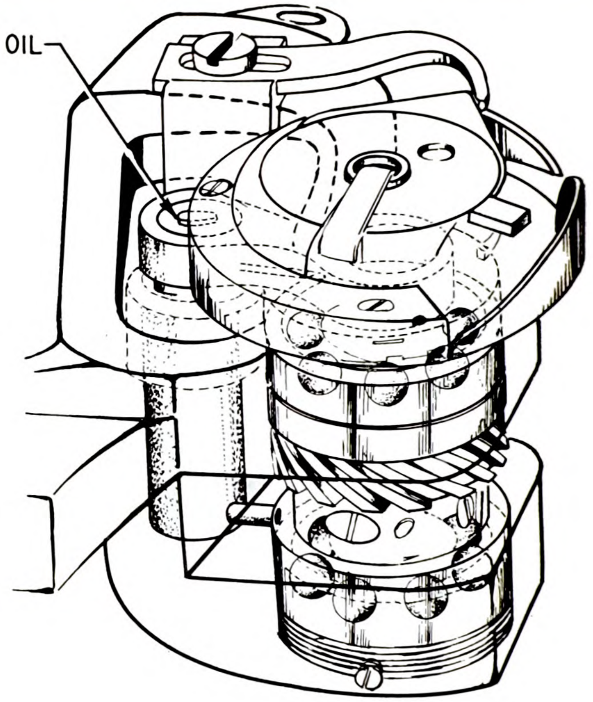


Figure 11-30.—Hook lubrication.

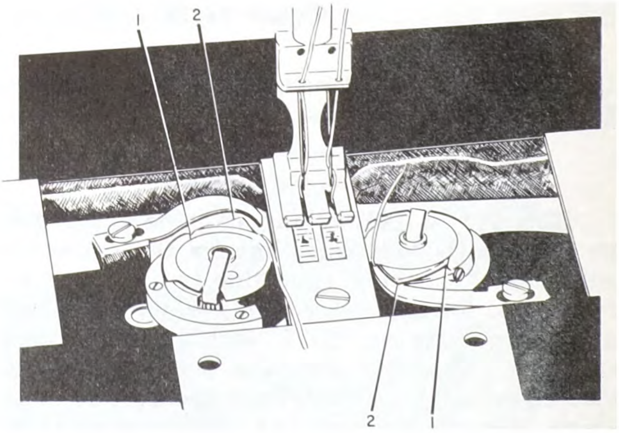


Figure 11-31.—Threading the bobbin cases.

1. Slot in the edge of the bobbin case.
2. Projection on the side of the bobbin case.

Bobbin and Bobbin Case

The procedure for removing the bobbin case, winding the bobbin, threading the bobbin case,

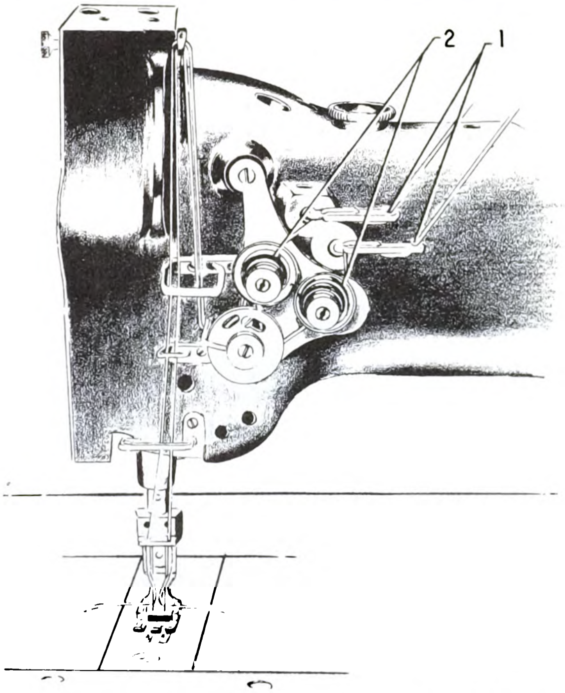


Figure 11-32.—Threading the 112 W 140 sewing machine.

1. Upper thread guides.
2. Tension discs.

and replacing the bobbin case is the same as for the 31-15 sewing machine. The only exception to this is that when threading the bobbin case, the thread should draw from the BOTTOM from left to right, instead of from the top as given for the 31-15.

Threading the Needle

These machines are threaded in the same way as the 111 series machines, described earlier in the chapter. When threaded up to the needle, thread the needle from the front through the eye to the back. The long thread groove should be in front when the needle is properly set in the needle clamp.

Regulating the Length of Stitch

Press the stitch regulator lever and at the same time turn the balance wheel over toward you until the lever engages the notch in the stitch regulator flange. Continue to hold the lever in the notch in the flange and at the same time turn the balance wheel backward or forward, as required. When the desired number of stitches is obtained, as indicated on the stitch regulator flange (seen through small hole on the upright above the lever), release the lever.

Regulating the Width of Bight

The width of bight of the zigzag stitch is regulated by means of the needle vibrator regulating spindle head on the front of the machine. To increase the width of the zigzag stitch, turn the regulating spindle head counterclockwise. To decrease the width of the zigzag stitch, turn the regulating spindle head clockwise.

The thread tensions are regulated as given for the 111 class machines, and the pressure on the material is regulated by the thumbscrew, located on top of the sewing machine.

Turning Corners

Stop the machine while the needle is rising, but before it is out of the material, raise the presser foot and turn the work. This method uses the needle as a pivot.

Removing the Work

Raise the presser lifter (either hand or knee), turn the machine by the balance wheel until the takeup lever is at its highest position and draw the work away from you. If the threads do not draw out easily, the takeup lever is not in the right position. If the machine is stopped as directed, the needle will not be unthreaded when starting to sew, even if only a short end is left through the eye of the needle.

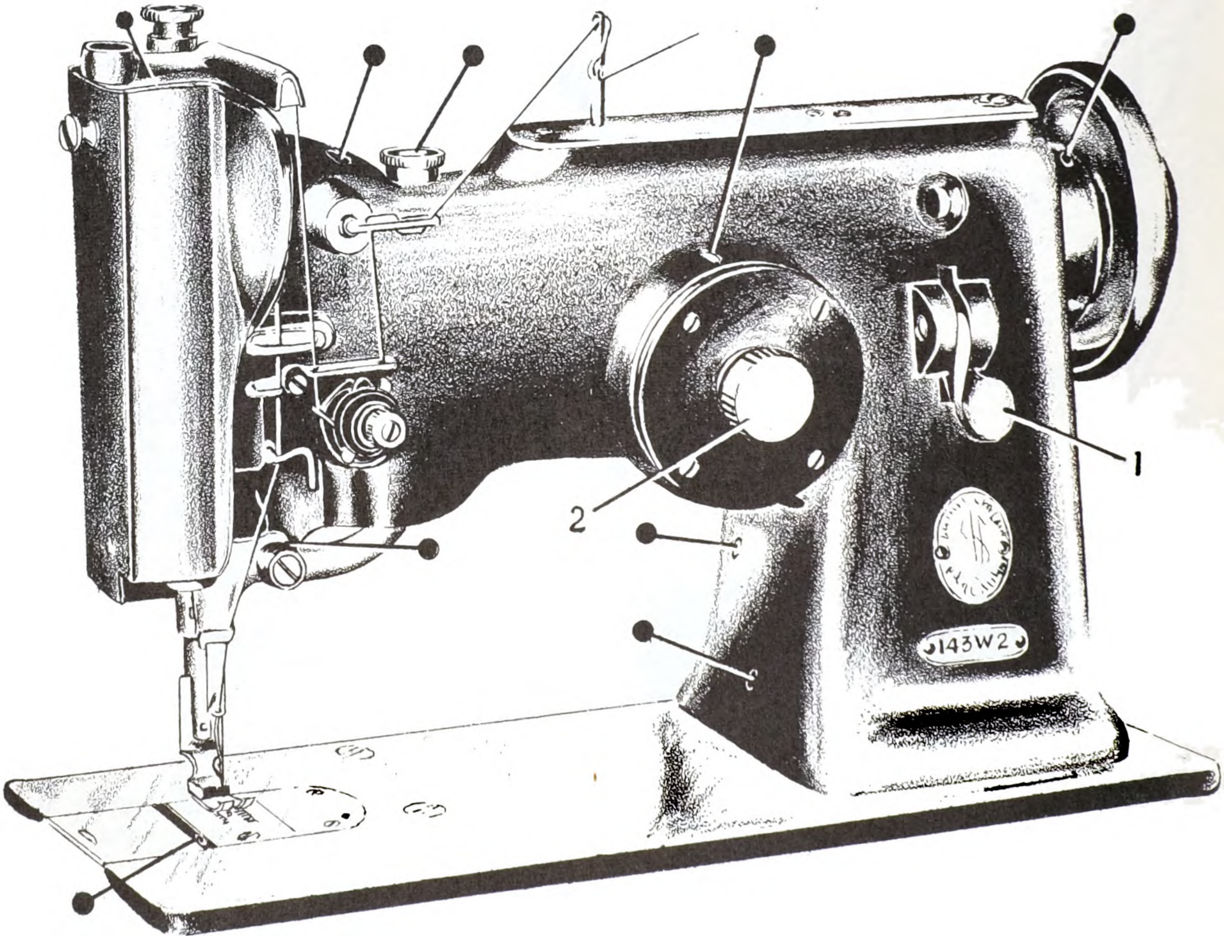


Figure 11-33.—Oiling points at front of machine.

1. Stitch regulator lever.
2. Vibrator regulating spindle head.

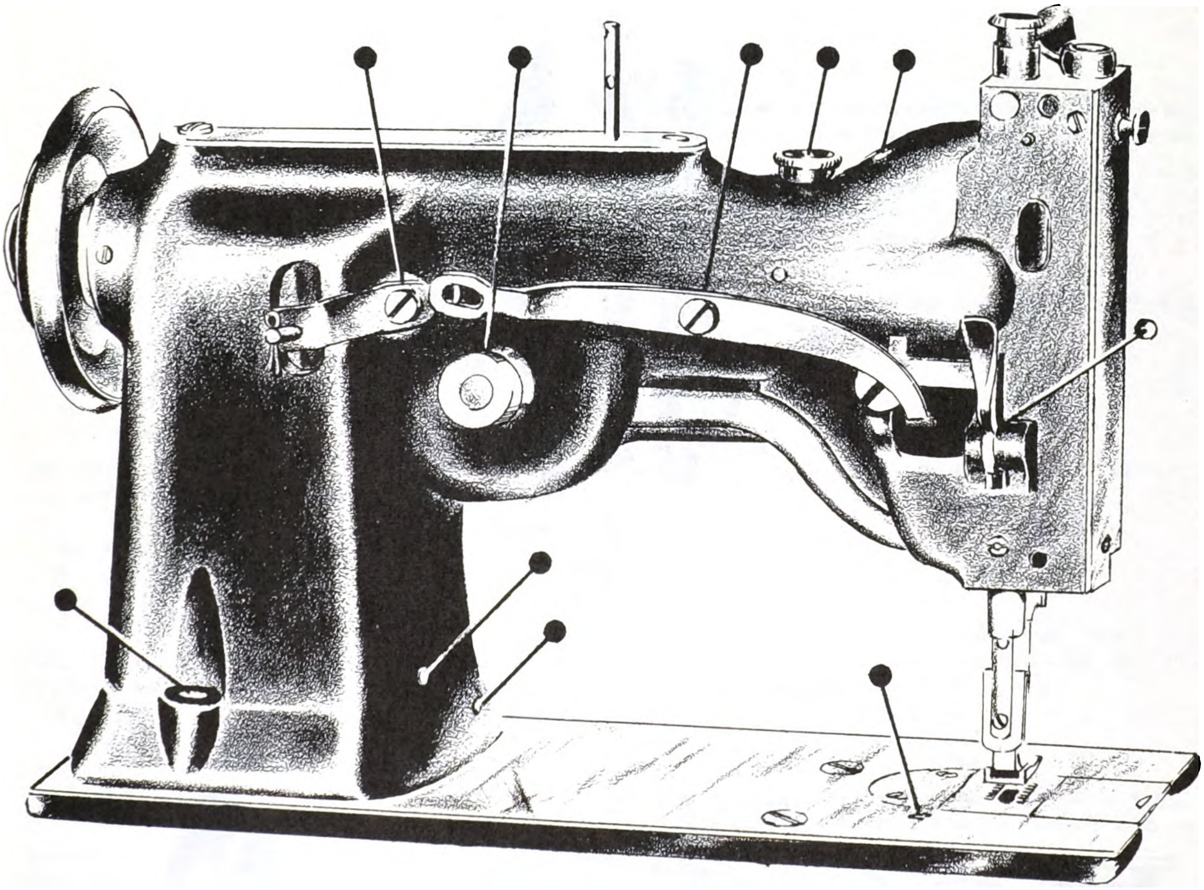


Figure 11-34.—Oiling points at back of machine.

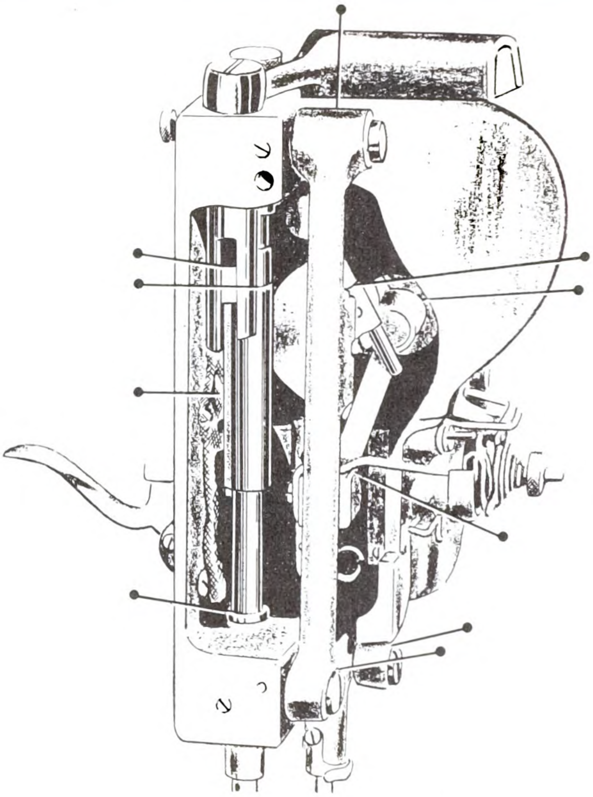


Figure 11-35.—Oiling points at end of machine.

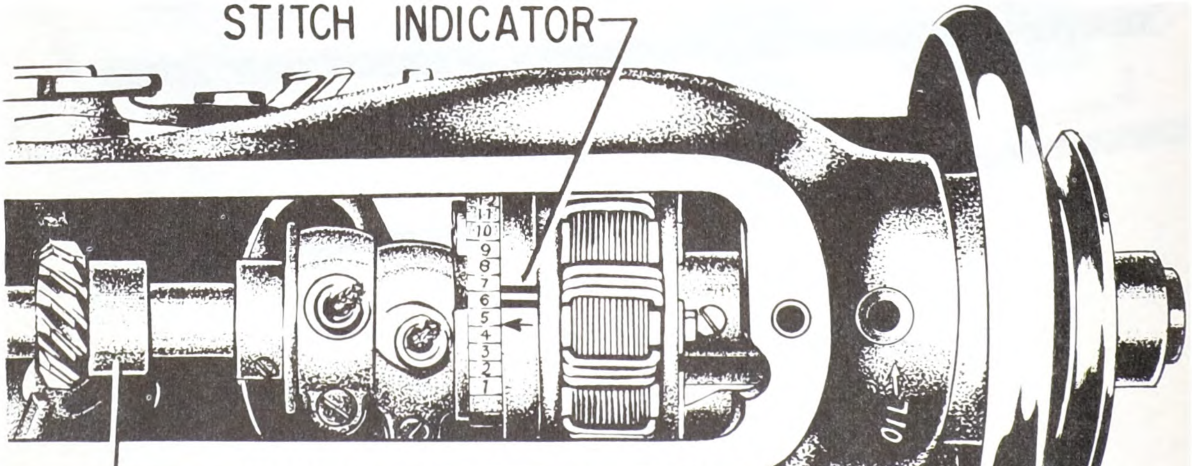


Figure 11-36.—Oiling points at top of machine.

QUIZ

1. The pressure on the presser foot on a 31-15 sewing machine is regulated by a
    a. thumbscrew on top of arm
    b. thumbscrew cap on top of presser bar
    c. locknut on lever on uprise
    d. thumbscrew in back of arm
2. The class and variety of needle to be used in the class 31-15 is
    a. 7 x 3
    b. 14 x 23
    c. 16 x 87
    d. 7 x 1 or 7 x 5
3. The proper size sewing machine needle to be used should be determined by the
    a. machine being used
    b. thread size and material being used
    c. speed of machine
    d. size of hole in feed dog
4. The part of the needle that should always face away from the sewing hook is called the
    a. scarf
    b. long thread groove
    c. shank
    d. short thread groove
5. When first starting to sew with any lockstitch sewing machine, the operator should
    a. hold both threads for the first two stitches
    b. not hold thread
    c. hold bobbin thread
    d. hold upper thread
6. Besides raising the presser foot, the knee lifter will
    a. engage the clutch of the motor
    b. release upper tension
    c. raise the pitman rod
    d. raise the needle bar
7. Needles for sewing machines should be ordered by
    a. the box
    b. quantity, size, class and variety
    c. number
    d. class and variety
8. A perfect lockstitch will lock in the center of the
    a. top ply of material
    b. bottom ply of material
    c. plies of material
    d. none of the above
9. One part not found on a 31-15 sewing machine that is a part of the 7-31 machine is a
    a. takeup lever
    b. tension wheel
    c. feed dog
    d. presser bar
10. The class and variety needle for the 111 W 155 is
    a. 16 x 87
    b. 135 x 7
    c. 135 x 17
    d. 135 x 55
11. To remove work from the 111 W 150 sewing machine, the thread takeup lever should be at its
    a. lowest point
    b. highest point
    c. upward stroke
    d. half stroke
12. Rotary type sewing machine needles have ____ parts.
    a. four
    b. five
    c. six
    d. seven
13. The maximum recommended speed for class 7 machines is ____ r.p.m.
    a. 450
    b. 550
    c. 2,200
    d. 3,500
14. When installing a bobbin on class 7 machines, the needle bar should be at the
    a. highest position
    b. lowest position
    c. top of throat plate
    d. half way position
15. To increase the needle thread tension, the tension thumb nut on the 31-15 should be turned
    a. left
    b. right
    c. toward operator
    d. away from operator
16. When operating a sewing machine with feet flat on the treadle, pressure applied to the toes engages the
    a. brake
    b. clutch
    c. drive belt
    d. bobbin winder
17. To regulate needle tension, you would increase
    a. or decrease pressure on tension discs
    b. or decrease bobbin tension
    c. bobbin tension
    d. thread controller action
18. The bobbin is placed into the bobbin case of the 111 W 155 so it will turn
    a. toward the operator
    b. away from the operator
    c. clockwise
    d. counterclockwise

19. When placing a needle into the needle bar of class 7 sewing machines, the needle should be placed into needle bar
    a. 1/16 inch
    b. 1/8 inch
    c. 1/4 inch
    d. all the way

20. When winding a bobbin and the thread is winding too loosely, you would
    a. use stronger thread
    b. turn tension thumb nut clockwise
    c. tighten regulating screw
    d. use larger bobbin

21. After setting the desired stitch length, make sure the plunger
    a. is engaged
    b. works freely
    c. releases
    d. indicates stitches per inch

22. When setting the needle into a 31-15 sewing machine, the eye should line up with the
    a. bed
    b. operator
    c. thread guide
    d. presser foot

23. When clearing work from the class 7, the thread takeup lever is at its
    a. downward stroke
    b. half down position
    c. high point
    d. lowest point

24. The recommended speed of the 111 W 155 is _____ r.p.m.
    a. 2,200
    b. 2,900
    c. 3,000
    d. 3,500

25. On a 31-15 sewing machine the long thread groove of the needle should face
    a. left
    b. right
    c. away from the operator
    d. toward the operator

CHAPTER 12

PARACHUTE MAINTENANCE AND REPAIRS

FABRIC MATERIALS

Materials used in parachute construction are of the very best grade obtainable. All of these materials—the fabric, webbings, cords, tapes, hardware, etc.—are made in accordance with strict government specifications.

A specification is a written document containing the details of construction and minimum standards for an item of material or equipment which has been ordered by a using activity. In the case of the Armed Forces, specifications are necessary to insure that the item ordered meets all the requirements for which the Government is paying and that the item will perform all the necessary functions.

The Armed Forces now procure most of their materials and equipment under a coordinated program. Items procured under this program are assigned a Military (MIL) Specification Number. The MIL Specification Numbers listed in this chapter are in effect as of the current date; however, specifications are revised from time to time, and specification numbers are often changed, canceled, or superseded. An index, titled *List of Military Specifications and Standards,* NA 00-25-544, lists all specifications in effect and those recently canceled. This Index is reissued periodically under the supervision of the Bureau of Naval Weapons and is available in your technical library.

As a Parachute Rigger, you must not tolerate the use of substitutes or substandard materials in the fabrication or repair of survival equipment. A knowledge of specifications and tensile strengths will better equip you to design local projects which must meet specific tensile strength requirements.

Types of Fabric Materials

NYLON PARACHUTE CLOTH

Nylon parachute cloth is made in accordance with Specification MIL-C-7020B (ASG). This cloth is neutral in color unless otherwise specified, and is used in constructing the gores and panels of the parachute canopy. The specification states that the maximum weight cannot be more than 1.1 ounces per square yard. The breaking strength in minimum pounds per inch of width is 40 pounds. The minimum tear resistance is 3.5 pounds for both the warp and filler thread. The air permeability in cubic feet per minute per square foot of cloth is 80 to 120.

NYLON CORD

Nylon cord used for suspension lines for pilot chutes and parachutes is made in accordance with Specification MIL-C-5040A (ASG). Type I cord, 100 pounds breaking strength, is used for the lines of Martin-Baker pilot chutes. Type III, 550 pounds breaking strength, is used for constructing the suspension lines of the canopies of all service parachutes.

NYLON REINFORCING TAPE

Reinforcing tape comes in many widths and styles. This tape is used on parachute container reinforcements, edgings, making hesitator loops and retainers, and general strengthening of all stress areas. Tapes are made in accordance with Specification MIL-T-5038A-1.

Many of the tapes can be identified by observing the patterns of their weaves. Type II tape is a plain weave. Type IV tape is composed of two ground warps. Type VI tape is a herringbone style which differs only slightly from type IV.

Type II tape is 3/4 inch wide and has a minimum breaking strength of 400 pounds. Type IV tape comes in both 1-inch and 1 1/2-inch widths. The 1-inch width has a minimum breaking strength of 1,000 pounds, while the breaking strength of the 1 1/2-inch is 1,500 pounds. Type VI tape is 3/4 inch wide and has a breaking strength of 425 pounds.

NYLON WEBBING

Soft textile nylon webbing is used for constructing parachute harnesses. This webbing, 6,000 pounds breaking strength, is olive drab in color. The width is 1 23/32 ±1/16 inches.

NYLON TUBULAR WEBBING

Nylon tubular webbing is neutral in color and is used in reinforcement of the parachute canopy.

These webbings are covered in the following specifications:

MIL-W-4-88B (USAF).
MIL-W-6134.
MIL-W-5625.

The 1-inch nylon tubular webbing has a breaking strength of 3,000 pounds and is used for the vent reinforcement. The nylon warp and cotton filler webbing is also 1 inch and has a breaking strength of 525 pounds. It is used to reinforce the skirt hem. The 1/2-inch tubular webbing has a breaking strength of 1,000 pounds and is used for the Martin-Baker pilot chute connector cord.

ENEMIES OF FABRICS

Damage by Acid

Contamination by acid is probably the most serious damage which can be sustained by parachutes, mainly because the action is rapid and can have far-reaching effects. Unless constant vigilance is maintained for acid detection, contamination and weakening of the parts of the parachute may proceed undetected and might result in serious consequence in the event of emergency use. It is imperative that the utmost care be taken by all personnel to prevent acid from contacting parachute equipment. Only clean vehicles should be used for transporting parachutes in operating units; and particular caution should be observed so that parachutes are not transported in vehicles previously used for transporting wet-cell storage batteries.

Any item of parachute equipment suspected of having been in contact with acid must be isolated from all other parachute equipment and tested immediately. Similarly, equipment having been in contact with an article known to be contaminated must be isolated and tested. Not only must the complete article be isolated, but the suspected portions of it must not be allowed to touch any other portion so that the damage is restricted as far as possible.

Litmus paper provides a reliable and simple means for detecting the presence of acids or alkalies. Blue and red litmus paper is available through standard stock issue. To test for acid content, dampen the affected area with distilled water while touching it with a strip of blue litmus paper. If the blue color turns to red, acid is present. To test for an alkali, dampen the affected area with distilled water while touching it with a strip of red litmus paper. If the red color turns blue, an alkali has been detected. Immediate steps must be taken to neutralize the caustic and damaging effects of these elements.

Canopies badly stained with grease, oil, or other injurious substances should be returned to a major repair station for repair after steps have been taken to neutralize the damage.

Synthetic materials, such as nylon, orlon, and dacron, originating from vegetable matter, have one great factor in their favor, the ability to resist the effects of weather. Nylon, the principal material used in manufacturing parachutes and innumerable articles of flight clothing, occupies a commanding lead among materials for fulfilling the needs of the Navy. In view of these facts, some individuals become careless and do not always exercise their best judgment in handling items manufactured from the so called ''miracle fibers.''

Regardless of the factors favoring nylon with all its reserves of strength, elasticity, and durability, prolonged exposure to the destructive elements of sunlight, salt water, and dirt will dangerously weaken the material, rendering it useless for further use in a parachute. Part of your job is to safeguard the parachute from contact with the aforementioned elements plus evading the destructive qualities of battery acid, oils, greases, mildew, and insects.

A stain not only ruins the appearance of an object but it also could cause physical damage. We are primarily interested in the damaging effects of a stain. Certain oils, dirt, food, and other products contain acids in varying percentages.

A strong acid is certain death to fabric and rapidly brings about the complete deterioration of the affected area. The time necessary to bring about its destruction is determined by the strength of the solution. It is your job during the inspection of the parachute to locate stained areas and to test these for acid or alkaline content.

Whenever definite evidence of acid contamination is found, the damaged parts should be treated immediately with ammonia to neutralize the acid and be allowed to dry thoroughly. A 50-percent solution of 0.880 liquid ammonia and distilled water is recommended, but if not available, ordinary clear domestic ammonia may be used. The solution should be applied to the affected part with a swab or small piece of sponge tied securely to a stick. Do not be afraid to use an excess of ammonia as this chemical is not injurious to the material or hardware. A bottle of the solution should always be kept in the parachute loft ready for immediate use.

The presence of acid stains on a pack indicates the possibility of serious contamination of the main and pilot chute canopies and suspension lines and calls for very careful inspection of the whole parachute, including the harness. All packs must be inspected daily for signs of acid stains, particularly on completion of a flight. The stains can be recognized by their appearance, being putty-colored at first and then changing to white. The stains are more readily discernible on the clean interior of a pack than on the outside, which may be soiled.

If signs of acid stains are noted, the pack must be opened immediately, the pack put aside and the canopy and pilot chute examined and tested as detailed in the following paragraph. The acid on the pack must be neutralized to prevent further damage and the pack kept isolated for 10 days and frequently inspected for further signs of contamination, which should be treated as they appear. If, after this period, the damage is small, the affected portion should be neatly cut out and the hole patched; otherwise the pack must be discarded.

The main canopy and pilot parachute released from a pack contaminated with acid, or known to have been in contact with any piece of equipment suspected of acid contamination, should be isolated immediately and thoroughly examined and tested for signs of damage. If contaminated areas are discovered, they must be neutralized at once with ammonia as previously described, care being taken to treat only one thickness of material at a time. If ammonia cannot be obtained, the defective portions must be carefully cut out and burned. If the contaminated area is 8 square inches or less, it must be cut out and patched. If the contaminated area is greater than 8 inches, the affected area must be neutralized and cut out and the entire parachute sent at once to a major repair station for repairs. Should damages of a small area appear on many of the gores of the same parachute, the entire parachute must be sent to a major repair station for overhaul. Should no signs of damage be found, the canopy must be hung for 10 days, isolated from all other equipment, and frequently inspected to see whether damage becomes evident. If, after this period, there are still no signs of contamination, the canopy may be put back into service.

Contamination of a harness by acid is more serious than to any other portion of a parachute. A harness so damaged must be returned to a major repair station for inspection and possible repair or replacement. Harnesses suspected of contamination must be isolated and tested immediately with litmus paper. Before packing for transport, the parts damaged by acid must be neutralized with ammonia as already described; or in the absence of ammonia, the damaged parts must be cut out and burned. When contamination is suspected, but no definite evidence is immediately detectable, the procedure of isolation and frequent examination for a period of 10 days must be followed. If no damage is detected, the equipment may be put back into service. Wherever any element of doubt exists as to the condition of the harness equipment, it must be discarded for use, in the interest of safety to personnel.

Examination of even a new parachute canopy will reveal occasional slight displacement of threads of the material especially along or near the seams. Normal defects in the weave will also be found. These defects are not detrimental to the strength of the material and need not be corrected. Under no condition should such places be pulled or stretched by hand as such treatment tends to weaken the material and will convert a harmless displacement into a bad strain which will require repair. A strain considered as not warranting a repair should be noted on the canopy chart for the information of the major repair station. When weakness of the material is suspected, the canopy should be sent to a major repair station for inspection and possible test.

Water Damage

RIVER, LAKE, OR POND WATER

If, for any reason, a parachute should fall into natural fresh water, it must be rinsed as soon as possible in several changes of fresh tap water in a tank or tub and dried. Great care must be taken to handle the material carefully. The water must not be wrung out by twisting the fabric parts in the hands, but must be allowed to drip dry. If a parachute has been immersed in natural fresh water two or more times and there is reason to suspect the material has been weakened, the parachute should be returned to a major repair station for drop testing. The parachute must be hung to dry in accordance with the procedures previously outlined in chapter 4.

SALT WATER

It is imperative that parachutes which have fallen into salt water or become wet from perspiration be subjected to prolonged rinsings with fresh water before being permitted to dry. The effect of the chlorides on nylon canopies is not severe, but nevertheless, these steps must be taken. Chlorides in the form of salt, etc., may be deposited upon the canopy by the introduction of salt water even when the total immersion has not occurred.

The parachute must be thoroughly washed after any contact with salt water, however small it may be, or upon the appearance of the characteristic stain indicating such contact. Salt can be removed from the material easily, but difficulty will be encountered in removing it completely from the thick parts of the harness. Special attention must be given to those parts where metal fittings are attached, for any remaining traces of salt can result in the start of dangerous corrosive action. The parachute must be immersed in a bath of fresh tap water for 2 or 3 hours in order for the water to dissolve the salt from the inner fibers of the webbing and the thick areas of seams. For subsequent rinsing, whenever possible, the parachute must be suspended full length by the vent and a gentle stream of fresh water played on it from a hose.

In cases such as aboard small vessels, when the hose and suspension method cannot be employed, parachutes may be rinsed in a tank or tub under a constant stream of running fresh tap water. The rinsing water may be warm but not hot. Always obtain permission, aboard ship, prior to using large quantities of fresh water. Never wring the water out of the canopy by twisting it with the hands or with mechanical wringers, as this causes objectionable wrinkles in the material and may pull it to dangerous proportions. Exposure to direct rays of the sun adversely affects nylon, tending to reduce its strength and shorten its life. Drying must be done in the shade, and exposure to the sun avoided. Parachutes which have been immersed in salt water for extended periods of time, or which have been allowed to dry, before rinsing, must be forwarded to the nearest major repair station for examination and test of materials.

PRECAUTIONS AGAINST RAIN, DEW, AND PERSPIRATION

Whenever a parachute is in use, it should be protected as much as possible from dampness. Packs and/or harnesses must not be left in an open cockpit, or anywhere in the open, when there is the least likelihood of rain or heavy dew, nor should they be placed on wet grass. Before being placed in lockers or other receptacles, packs and/or harnesses should be examined for dampness from rain, dew, or particularly in the tropics, from perspiration. If found to be damp from perspiration, the directions set forth under ''SALT WATER'' must be executed. If found to be damp from rain or dew, parachutes must be released, dried, and repacked.

MILDEW AND FUNGUS GROWTH

Parachutes are particularly susceptible to mildew in warm humid climates. As the propagation of fungi or mold is dependent to some degree on a nutrient in the material which may be oil, grease, starch, sizing, or other foreign substance, parachutes must be kept as clean as possible. In such locations where mildew is prevalent, parachutes must be kept in a tight locker or bin, at the bottom of which is placed a suitable container for dispensing naphthalene fumes. Three pounds of napthalene flakes will penetrate the parachute sufficiently to prevent the formation and growth of fungi. Under extreme climatic conditions, approximately 1/8 pound of naphthalene flakes should be sprinkled over the unpacked parachute within the container or over the folded gores of the canopy prior to the final folding operation when packing the parachute.

PARACHUTE CLEANING

Parachutes requiring extensive cleaning should be forwarded to a major repair station. If the major repair station cannot satisfactorily clean the parachute, it should be sent to a commercial cleaner for dry cleaning in accordance with established specifications. When forwarding parachutes to a major repair station, a report must be attached to each parachute, describing the nature and location of the stains, and the Parachute History Card, NavAer 2771, completed, containing the required information. It is of great assistance when cleaning parachutes to know definitely whether the stains were caused by oil, acids, or other agents.

If the parachutes are not too badly soiled, or stained, they may be cleaned by operating units, provided the following directions and precautions are rigidly observed. Soiled parachutes should be washed with clean, fresh water. The water may be warm but must not be hot. Sand or dust should not be brushed off; the parachute must be thoroughly shaken to remove these foreign substances. If mud is caked and dried on the material, the surface must not be brushed. The affected area should be immersed in water, and permitted to soak; the water should be agitated until the mud is loosened. When dirt and stains are difficult to remove by water alone, an approved dry-cleaning solution may be used. If the harness has been detached, the lines should be chained together to reduce the length. All metal parts should be covered with heavy cotton flannel. If the harness has not been detached, it and the attaching hardware should be placed in a suitable net bag. After washing the parachute in the cleaning mixture, it should be thoroughly rinsed several times in fresh dry-cleaning solution until the rinsing solution remains clear. The parachute should then be suspended in the shade to dry.

In removing stains and dirt, the stained area must be completely immersed in the cleaning mixture and the liquid agitated while the material is held submerged. The flow of the liquid around and through the material will be sufficient to clean it. The material must not be rubbed together or scrubbed with a brush or cloth saturated with the fluid, as such rough handling damages and weakens it. Prepared commercial cleaning solutions must not be used since they may cause damage to nylon, which is a synthetic material. The use of flammable fluids in cleaning nylon parachutes must be avoided, since nylon has a tendency to collect static charges which may result in a spark that might ignite the fumes. To remove blood stains, the parachute must be washed in clear, cold water, as warm or hot water will coagulate blood and render it difficult to remove. The use of a "digester," which may be obtained from a dry-cleaning establishment, is recommended in removing blood stains. Drying after cleaning should be done in the shade, in view of the adverse effect of sunlight on the canopy materials. While the above procedure can be carried out by operating activities, provided great care is taken, especially in insuring thorough rinsing, it is strongly recommended that parachutes badly soiled be sent to a major repair station.

Stain Removal

Before using any chemical or water on a stain, try a drop or two on a seam or hem to test its reaction. Be sure to take this precaution when using a remover containing acetone because this chemical will dissolve rayon acetate. When using water or a solvent, work on the wrong side of the material, placing a white blotting paper or a pad of folded material under it to absorb excess liquid. Change this blotter when it becomes soiled or ceases to absorb. Dip a clean, soft cloth in the solvent and wring it partially dry before brushing it lightly and irregularly over the spot and surrounding material.

When using chemicals, work rapidly, making several brief applications followed by rinsings. After stretching the stained section of the material over a bowl or pad of cloth, apply the chemical with a medicine dropper. After the spot has been removed, dampen a wad of cotton with the cleaning solution and rub with very light strokes in the direction of the grain of the material in order to avoid rings. Dry quickly.

Rayons and other synthetic materials, being generally of cellulosic content, react with chemicals similarly to cottons, but this should not be considered the rule. Other types of synthetic fibers, on the other hand, react like woolens. Generally when wet, rayons and protein fibers are extremely weak and should be handled with extreme care in order to avoid mechanical injury. Contact with organic solvents, such as alcohol, acetone, benzol, chloroform, and glacial acetic acid, will affect the synthetic fiber and must therefore be avoided.

Instructions and suggestions are given for the removal of the more common types of stains in table 12-1.

STENCILING PARACHUTES AND COMPONENTS

Parachutes are marked by the manufacturer in accordance with the general specifications for parachutes. In order to help identify the parachutes of local units it is permissible to

Table 12-1.--Instructions for the removal of stains.

<table>
<tr><th>Stain</th><th>Cotton or linen (vegetable fiber)</th><th>Wool or silk (animal fiber)</th></tr>
<tr><td>Acids</td><td colspan="2">Nitric acid sometimes yellows white textiles. Phosphoric acid (frequently present in sirups) yellows wool. The color of many dyed materials is destroyed by acids. Sponge with dilute ammonia or sodium bicarbonate. Rinse well in water afterwards.</td></tr>
<tr><td>Alkalies</td><td colspan="2">Alkalies sometimes destroy certain colors. Sponge with dilute acetic acid. Rinse free from acid afterwards. Starch is yellowed by alkalies at high temperatures. Scouring will remove such stains.</td></tr>
<tr><td>Blood</td><td>Removed in standard washing process. Javel water removes hemoglobin, the coloring matter. Stubborn stains may be removed with glacial acetic acid. Be careful of colored materials. Rinse well.</td><td>Removed in standard washing process. Sponge with a little hydrogen peroxide to remove last traces.</td></tr>
<tr><td>Chewing gum</td><td colspan="2">Carefully remove mechanically, then spot with safety solvent. Finally wash by hand with soap. Rub well.</td></tr>
<tr><td>Cocoa, coffee, and chocolate.</td><td>Remove in the standard washing process.</td><td>Residual traces may be removed with oxidizing bleaches.</td></tr>
<tr><td>Grass</td><td colspan="2">Removed in the standard washing process. Treat last traces with methanol or sodium bisulfite. Cotton and linen only may also be treated with Javel water.</td></tr>
<tr><td>Grease</td><td>Grease stains are usually removed in the standard washing process. If an exceedingly resistant stain is encountered, it may be softened with a mixture of lard and oleic acid (2 parts oleic acid to 98 parts of lard) and washed. When the oleic acid comes in contact with alkali in the usual bath, soap is formed, and being in such intimate association, with the grease, removes it rapidly. Organic solvents may also be used as listed in next column.</td><td>Stains surviving the regular laundering process must be treated with an excess of soap by hand or with one of the organic solvents, such as isopropyl alcohol (Spec. MIL-F-5566) and a safety solvent, or Stoddard Solvent. CAUTION: Avoid inhaling vapors and use with adequate ventilation.</td></tr>
<tr><td>Gum or resin</td><td colspan="2">Use any of the following solvents: Turpentine, safety solvent, isopropyl alcohol, or kerosene. The specific solvent must be determined by actual test, since the solubility of different gums varies.</td></tr>
<tr><td>Iodine</td><td colspan="2">Spot with sodium thiosulfate solution and rinse thoroughly.</td></tr>
<tr><td>Machine oil</td><td colspan="2">The stain can be removed only after the manner described under ''Grease.'' If the stain is caused by bearing grease, it may contain some iron and other metal.</td></tr>
<tr><td>Mildew and mold</td><td>Fresh, light stains are removed by standard washing process. Old stains may be treated with Javel water.</td><td>Potassium permanganate followed by hydrogen peroxide. Soap and water are satisfactory in very light cases.</td></tr>
</table>

Table 12-1.—Instructions for the removal of stains. (Continued)

Stain	Cotton or linen (vegetable fiber)	Wool or silk (animal fiber)
Mud	Removed in standard washing process. If an iron residual stain persists, remove as usual with oxalic acid or laundry soap. Rinse well.	
Paint and Varnish	These stains are more easily removed if treated before being laundered. Rub oleic acid into the stain. This is very important, especially for heavy stains. Then soak in all oleic acid-benzine mixture overnight (1 part oleic acid to 3 parts benzine). In the morning wash the material well in hot soda ash solution. The soda ash reacts with the oleic acid to form a "red oil" soap.	Use the following solvents: Turpentine, Stoddard Solvent, and safety solvent. CAUTION: Use with adequate ventilation.
Perspiration	If not removed in the standard washing process, treat with Javel water or with potassium permanganate solution followed by oxalic acid.	If the stain does not wash out, use potassium permanganate solution followed by oxalic acid.

stencil certain external appendages with an approved marking fluid.

The rules for stenciling parachutes locally follow:

1. Use currently approved marking fluid.
2. Avoid marking names directly on the equipment; use a length of tape which can be sewed or tacked to the equipment.
3. The exact place to mark and the size of the lettering depend on the equipment and how it is stored.
4. Identifying marks such as locally assigned numbers must be confined to the back pad and pack. Do not stencil the harness or canopy.

Use an appropriate size (1/2 inch to 1 inch) adjustable metal stencil. Join each letter properly in the grooves provided. When the stencils are joined, align the letters or figures in order to prevent a wavering line. Use the end plates provided in each kit, which offer the necessary margin to prevent smearing the marking ink off the ends. Hold each letter down tightly as the fluid is applied with a dampened brush. Do not attempt to stencil with a wet brush as the fluid will run off in all directions. Wipe the back of the stencil clean with a dry cloth between each operation. Before storing, clean the adjustable stencils in a safe cleaning solvent.

STITCHES, SEAMS, AND STITCHING

The Federal Standard Stock Catalog, DDD-S-751-1, Section IV (Part 5) is the official standard specification for stitches, seams, and stitching used in United States Government work. The information which follows is taken from this specification. Parachute blueprints and specifications reference the different type seams and stitchings wherever they are to be applied.

As a prerequisite to an understanding of seams and stitching used in the fabrication of garments and sewed survival articles, a clear understanding of the terms employed is essential.

A STITCH is the UNIT of THREAD FORMATION in the production of seams and stitching.

A SEAM consists of a series of stitches JOINING TWO OR MORE PLIES of MATERIAL or MATERIALS.

STITCHING consists of a series of stitches embodied in a material for ORNAMENTAL PURPOSES or for FINISHING AN EDGE or for both.

A seam is used for joining or assembling materials in the production of an article; whereas, stitching is used for preparing parts for assembling, and includes ornamenting and finishing, such as clocking, crocheting, gimp stitching, panel stitching, serging, hemming, and similar operations.

Seams

The characteristics of any properly formed seam are strength, elasticity, durability, security, and appearance. The characteristics are discussed in the following paragraphs.

STRENGTH

A seam should be of sufficient strength to withstand the strain to which it will be subjected in the use or wear of the articles of which it is a part. The elements affecting the strength of a seam are:

1. The type of stitch used.
2. The thread combination used.
3. The number of stitches per unit length of seam.
4. The tightness of the seam.
5. The construction of the seam.

ELASTICITY

The elasticity desirable in a seam is determined by the elasticity of the material to be sewed. The elasticity of the seam should equal that of the material or materials joined. The elasticity of a seam produced of a properly formed, tightly drawn stitch, depends upon the type of stitch employed.

DURABILITY

The durability of a seam depends largely upon its strength and the relation between the elasticity of the seam and the elasticity of the material. In the less elastic, tightly woven, and dense materials, there is a tendency for the plies to "work" or slide in each other. To form a durable seam in such materials, the stitch must be tight and the thread well set to the material to minimize abrasion and wear by contact with outside agencies.

SECURITY

The security of a seam depends on the character of the seam, on the strength and durability of the thread used in forming the stitch, and on the type of stitch employed.

APPEARANCE

The appearance of a seam is largely controlled by the seam construction. Under certain conditions it is essential that both sides of the seam appear the same; as, for instance, edge-stitching coats where the lapel is turned.

CLASSIFICATION

Seams in general use are divided into classes. The seams in each class are subdivided into types. Each class and type is given a symbol for convenience in reference.

The symbol for each seam is divided into three parts. The first part denotes the class of seam and consists of two or more uppercase letters. For example "SS." The second part denotes the type of the class and consists of one or more lowercase letters. For example, "a." The third part denotes the number of rows of stitches used and consists of one or more Arabic numerals preceded by a dash. For example, "-1." The complete symbol thus becomes "SSa-1."

SPECIFICATIONS

The specification of a seam includes the seam symbol prefixed by the symbol of the stitch to be used therein; thus, a seam type SSa-1 formed with United States standard stitch type 301 (lockstitch) is specified as "301-SSa-1."

In seams where more than one type of stitch is used, the symbol of the type of stitch nearest the edge of the material is placed first in the specification. Thus, a seam type SSa-2 formed with one row of stitch type 505 and one row of stitch type 101 is specified as "505-101-SSa-1."

Likewise, in the case of the specification of a 2-operation seam, the symbol of the stitch used in the first operation is placed first in the specification. Thus, seam type SSe-2 made by joining two plies together with stitch type 401 and then turning and stitching down with stitch type 301 is specified as "401-301-SSe-2." Where the same type of stitch is used for both operations, the symbol of the stitch type is repeated in the specification.

UNITED STATES STANDARD SEAM CLASS SS

The general characteristics of this class of seam is that the plies of material are superposed and joined with one or more rows of stitches. Figures 12-1 through 12-3 are seam construction illustrations of a number of typical examples of seams falling under the class SS.

The seam type SSa-1 is formed by superposing two or more plies of material and uniting them with one row of stitches. (See fig. 12-1.)

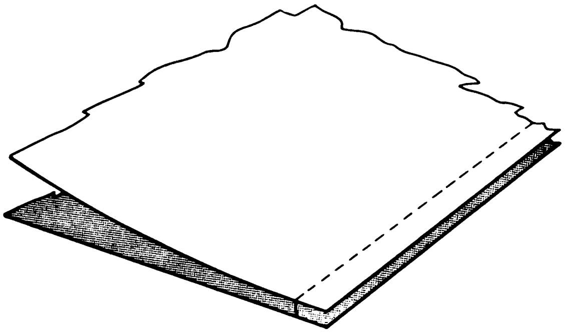


Figure 12-1.—Seam type SSa-1.

The SSc-2 type of seam is formed by turning the edge of both plies of the material to the inside and uniting with two rows of stitches. (See fig. 12-2.)

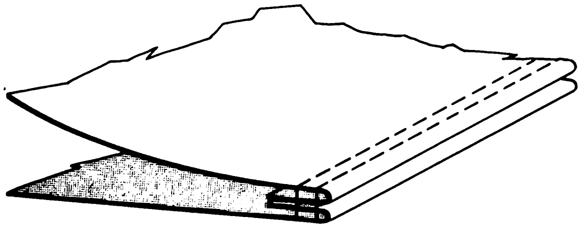


Figure 12-2.—Seam type SSc-2.

In making the SSe-2 type of seam, the plies of the material first are superposed and seamed as in forming seam type SSa-1. (See fig. 12-1.) The plies of the material are then turned and joined with one row of stitches, as shown in the seam construction drawing of figure 12-3.

UNITED STATES STANDARD SEAM CLASS LS

In this class of seam the plies of material are overlapped a sufficient distance to hold the stitches and are joined with one or more rows of stitches.

The LSa-2 type of seam is formed by overlapping two or more plies of material and uniting them with two rows of stitches, as shown in the seam construction drawing of figure 12-4.

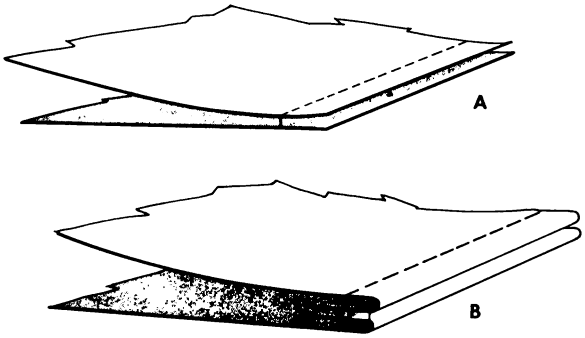


Figure 12-3.—Seam type SSe-2.

The LSb-2 type of seam is formed by turning the edge of one ply of the material and lapping it over another ply and uniting them with two rows of stitches, which also secures the turn-under portion of the one ply. The edge of the material on the outer surface will be concealed. (See fig. 12-5.)

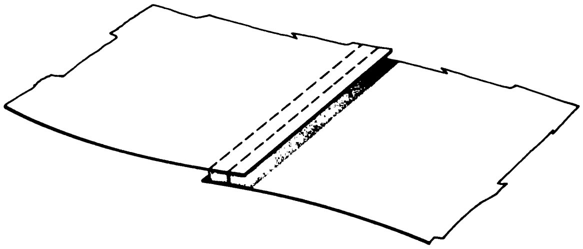


Figure 12-4.—Seam type LSa-2.

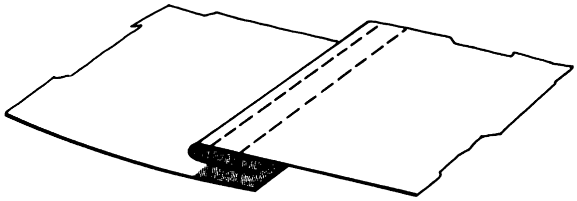


Figure 12-5.—Seam type LSb-2.

The LSc-2 type of seam is formed by turning the edges of both plies of material and lapping them, as shown in figure 12-6, and uniting them with two rows of stitches, which also must secure the turned portions. The edges of the material are concealed.

In making the LSs-2 type seam, the plies of material first should be joined, as shown in (A) of figure 12-7. One ply then should be turned

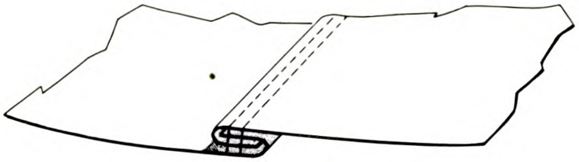


Figure 12-6.—Seam type LSc-2.

back and the plies united with a second row of stitching, as shown in (B) of figure 12-7.

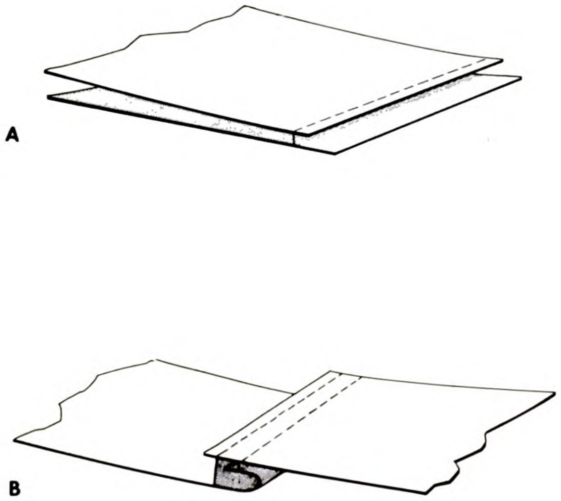


Figure 12-7.—Seam type LSs-2.

UNITED STATES STANDARD SEAM CLASS BS

This seam is formed by folding a binding strip over the edge of one or more plies of material and joining the plies and binding strips with a series of stitches.

The BSa-2 type of seam is formed by folding a binding strip over the edge of the ply or plies of body material and uniting the binding strip and body material with two rows of stitches. (See fig. 12-8.)

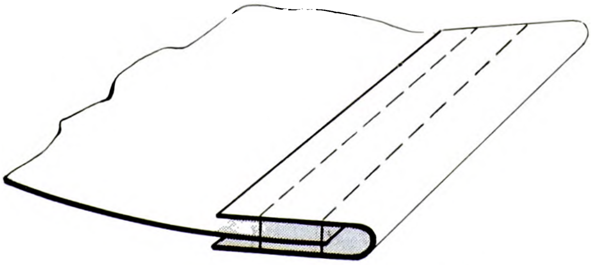


Figure 12-8.—Seam type BSa-2.

Stitching

Stitching in general use is divided into classes and each class subdivided into types. Each class and type is given a symbol for convenience in reference.

The symbol for each kind of stitching is divided into three parts:

The FIRST PART denotes the CLASS OF STITCHING and consists of two or more uppercase letters; for example, "OS."

The SECOND PART denotes the TYPE OF THE CLASS and consists of one or more lowercase letters; for example, "a."

The THIRD PART denotes the NUMBERS OF ROWS OF STITCHES used and consists of one or more Arabic numerals preceded by a dash; for example "-1." The complete symbol thus becomes, for example, "OSa-1."

SPECIFICATIONS

The specification of stitching includes the stitching symbol prefixed by the symbol of the stitch to be used therein; thus, for example, stitching type OSa-1, formed with United States standard stitch type 101, is specified "101-OSa-1.'

U. S. STANDARD STITCHING CLASS OS

This class of stitching is a series of stitches embodied in a material either in a straight line, a curve, or following a design.

The OSa-1 type of stitching is produced with one row of stitches. (See fig. 12-9.)

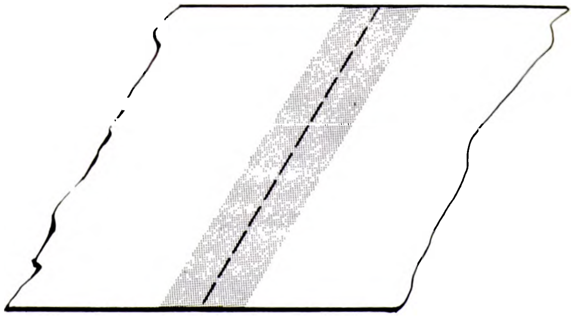


Figure 12-9.—Stitching type OSa-1.

The OSf-1 type of stitching is produced by folding and uniting the plies of the material near the fold. (See fig. 12-10.)

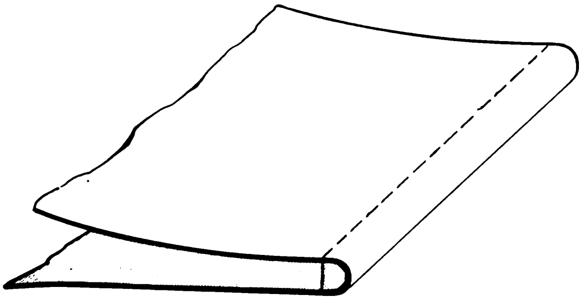


Figure 12-10.—Stitching type OSf-1.

UNITED STATES STANDARD STITCHING CLASS EF

This class of stitching consists of a series of stitches formed at or over the edge of a material, the edge being either folded or not folded, or the edge of the material is folded and joined to the body of the material with a series of stitches.

The EFb-1 type of stitching is produced by turning the edge of the material, folding it back over the body of the material, and uniting the portion so turned and folded to the body of the material with one row of stitches. (See fig. 12-11.)

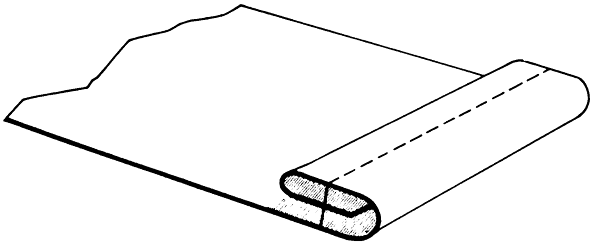


Figure 12-11.—Stitching type EFb-1.

The EFc-1 type of stitching is produced by turning the edge of the material, as shown in (A) of figure 12-12, and uniting the portion so turned to the body of the material with one row of stitches. In sewing, the material is so guided that the needle only partially penetrates the folded edge. When the material is laid flat, the stitches do not show on the outer face of the material. (See fig. 12-12.)

PATCHING THE PARACHUTE CANOPY

Single Patch

If the hole is one inch or less, use a single outside patch as diagrammed in figures 12-13, 12-14, and 12-15. The patch should be large enough to leave a margin of at least 1/2 INCH around the borders of the hole. (See fig. 12-13.)

In applying a single patch, and using a lock-stitch, sew two rows of stitching around the edges 3/8 inch apart, the first row of stitches 1/16 inch from edge of patch. Use size "E"

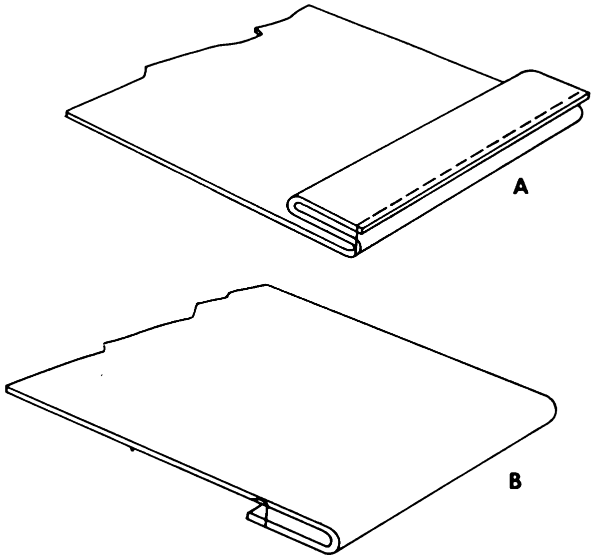


Figure 12-12.—Stitching type EFc-1.

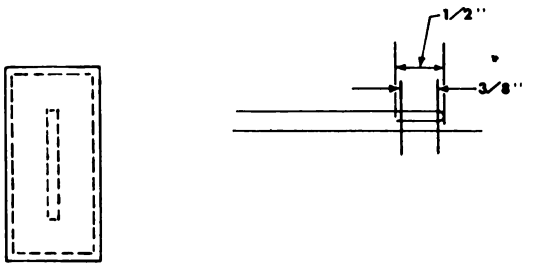


Figure 12-13.—Single outside patch applied to canopy section.

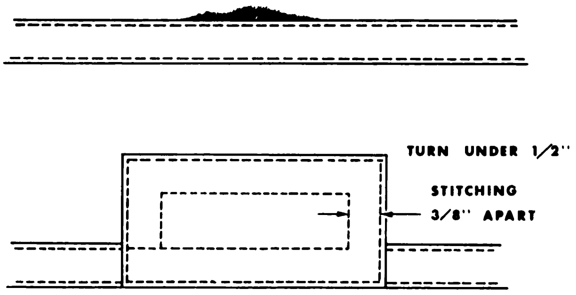


Figure 12-14.—Single outside patch applied to one side of a diagonal seam.

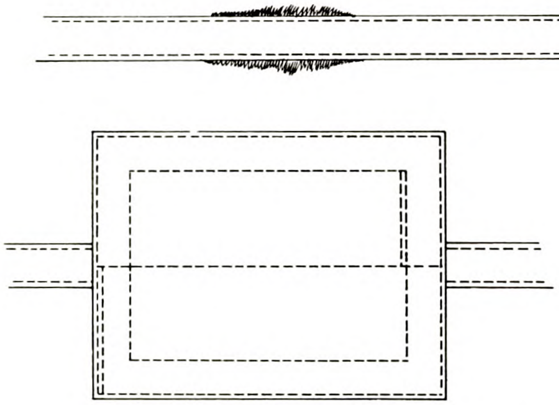


Figure 12-15.—Single outside patch applied to a diagonal seam.

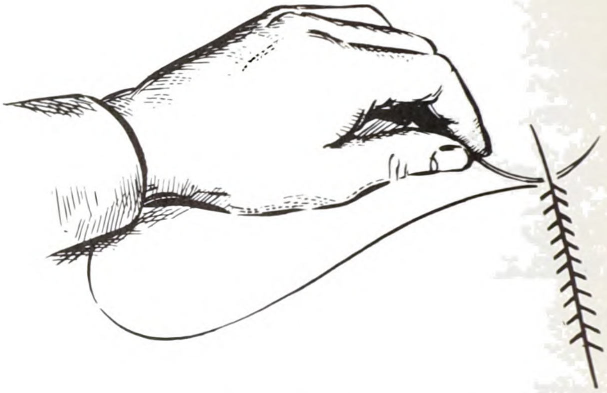


Figure 12-16.—The baseball stitch.

nylon thread, 8 to 10 stitches per inch, for sewing ALL PATCHES and other repair work on the canopy.

Holes larger than 8 square inches must not be patched. Only two single or one double patch must be allowed per section.

Cut the thread or the stitching as infrequently as possible. When the stitching of a seam has been connected, backstitch for at least 2 1/2 inches on radial seams or hems and 1 1/4 inches on the diagonal seams. If a patch is not anchored to a seam or hem, it must be backstitched 1 1/4 inches.

Where it is difficult to decide on a definite repair due to an overall deteriorated condition or damaged canopy, prepare the parachute for major overhaul.

The material used in the repair of canopies must be the same as that in the original canopy.

Misplaced or slipped threads in the weave of the material very often may be brushed back into place and a patch will not be required. Whenever several threads are broken they should be reinforced with a patch as indicated in figures 12-13, 12-14, and 12-15.

Double Patch

When the damaged area is not badly frayed, baseball stitch the tear as shown in figure 12-16. Do not draw the baseball stitches too tight, thereby puckering the area. In producing a smooth finish, maintain just enough tension on the stitches to bring the separated edges together.

Use a double patch for most repairs; that is, one patch inside the canopy and the other patch outside. The inside patch should be the smaller and must be applied first so that its stitching will be covered by the outside patch. The raw edges of a patch should be turned under 1/2 inch.

Large holes or tears require a double patch, one inside and one outside. After turning under 1/2 inch on all sides, the inside patch should be large enough to allow a 1-inch minimum margin on a 1-inch to 3-inch puncture; a 1 1/2 inch minimum margin on a 3-inch to 6-inch puncture; and a 2-inch minimum margin on a hole from 6 to 8 inches. Regardless of the hole size the outside patch must be larger than the inside one.

Using a soft lead pencil, lightly outline the area to which the patch will be sewed. Be sure to allow the correct minimum margin in relation to the perimeter of the finished or TURNED UNDER EDGE of the patch while marking and following the line of the weave around the damaged area. (See fig. 12-17.) Place the piece of new material with the weave correctly matched, warp for warp, filler thread for filler thread, over the outlined area. The material is very sheer and the penciled lines may be seen through the patching. Taking a pair of sharp scissors cut the patch to a size 1/2 inch larger overall than the penciled lines, the extra half inch being allowed for the hem.

In order to cut straight with the weave, it is advisable to pull a thread where the cut is to be made. (See fig. 12-18.)

Use the inside patch as a gage when cutting the outside patch. Place the inside patch on a piece of new material. Cut the new material 1/4 inch larger than the raw-edged perimeter of the inside patch.

Turn the edges of the inside patch under 1/2 inch. Baste or press the hem so it will stay in

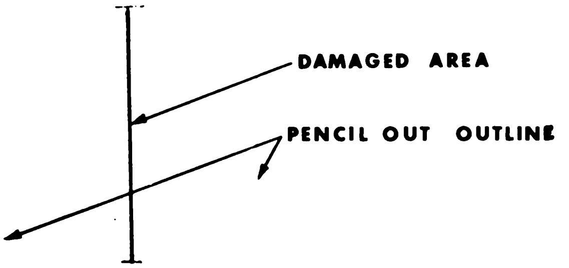


Figure 12-17.—Lightly outline the damaged area.

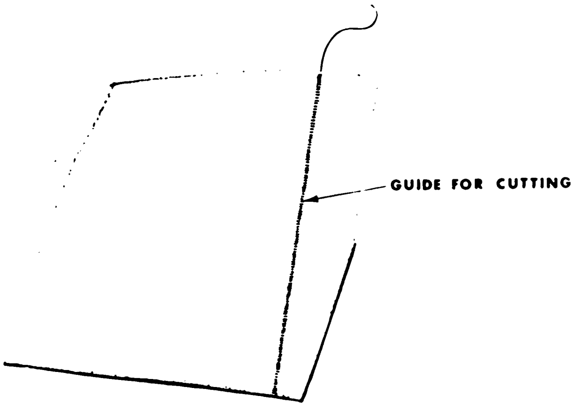


Figure 12-18.—Pull a thread from the weave to use as a guideline for cutting.

place when the patch is being sewed to the inside of the canopy. Apply the inside patch, sewing one row of stitches 1/16 of an inch from the edges.

Turn the edges of the outside patch under 1/2 inch. Baste or press the hem so it will stay in place.

Locate the outside patch over the inside patch so that their margins are even all the way around. A beginner will do well to baste the outside patch in place before attempting to sew it by machine. Sew one row of stitches around the outside patch edges 1/16 of an inch. Sew the second row of stitches 3/8 of an inch in from the edge row. Figure 12-19 diagrams this operation.

A badly frayed hole, if allowed to remain within a patch, may tend to roll or bunch, and will cause wrinkles. Accordingly, the damage must be trimmed to a rectangular shape. If the trimmed damaged area exceeds 8 inches across its widest dimension, the repair must be considered major and must not be undertaken locally.

After the material has been trimmed and rounded at the corners to prevent tearing, apply a filler patch as illustrated in figure 12-20. The filler patch merely acts as a binder to hold all of the separated edges together and prevents objectionable wrinkling.

After the filler patch, apply the inside patch, observing the same general rules as outlined for marginal allowances. Then apply the outside patch.

For additional strength, always try to anchor one or more sides of the patch to a seam or hem. NEVER sew through a suspension line. Where it is feasible to anchor the patch to a seam, the dimension of the patch may be extended on the applicable side. Figure 12-21 illustrates a patch anchored to a radial and a diagonal seam.

REPLACING PARACHUTE COMPONENTS

Vent Ring

Broken vent rings cannot be repaired. Damaged vent rings must be replaced. To replace the rubber-vent ring, open the hem, remove the old ring, insert the new ring, and resew the hem.

Harness

Parachute harnesses requiring repair work other than the correction of several (7 or 8) broken or defective stitches, except in the lift web to link sewing should be replaced by a new or serviceable harness. The only exception is in the end of the lift web sewing where it is connected to the links and where no defects are permitted. THERE MUST BE NO DEFECTIVE STITCHING IN THE LIFT WEB TO LINK SEWING. Applicable technical publications should be reviewed for instructions on various valid modifications to be made to existing harnesses to convert them to the latest specifications. Before making any modification, always check to be certain that it has not been canceled or superseded by a later directive.

Harnesses are currently issued with lift webs presewed for the convenience of installing them in the field. Of all stitchings, the connective ones are the most important to security.

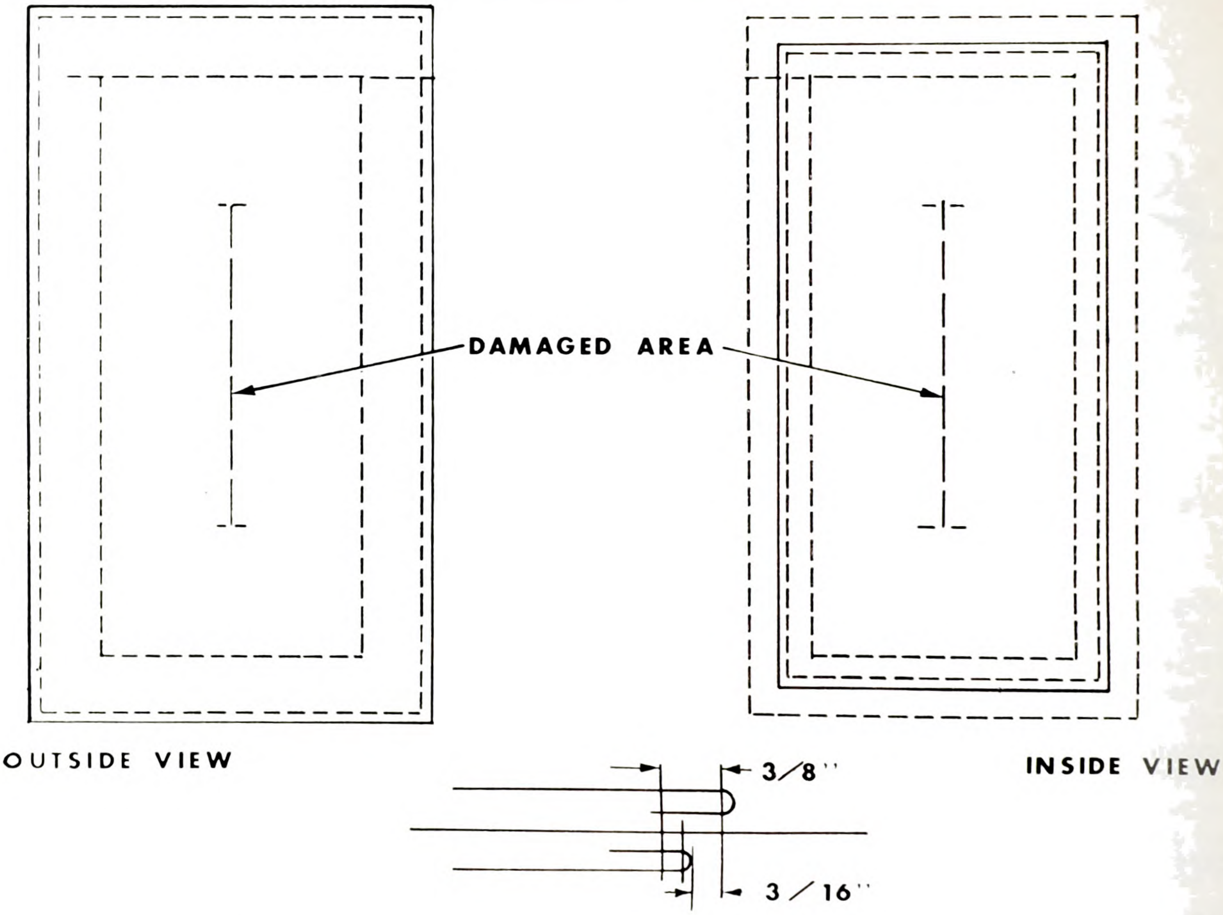


Figure 12-19.—Double patch applied to a canopy section.

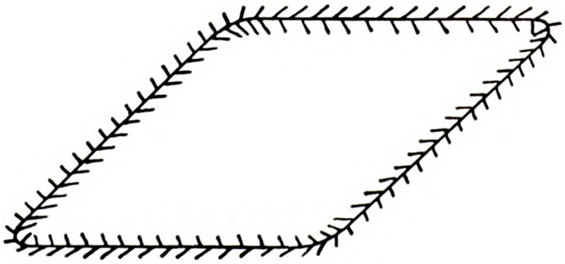


Figure 12-20.—Filler patch applied.

Pilot Chute

If the pilot chute has deteriorated to such an extent that repairs are impractical and uneconomical, or may impair the efficiency of operation, a complete new pilot chute should be substituted. If the spring is weak or defective, or if evidence of general deterioration is observed, the entire pilot chute assembly must be replaced by a new or serviceable one.

Tears, holes, or chafed places in the canopy of the pilot parachute should be repaired in accordance with the instructions detailed for repairs to the main canopy.

Replace missing tacking threads which hold the spring in place.

RENEWING THE TIE CORD

When the tie cord has to be replaced and the old tie cord does not correctly separate the suspension lines of the main canopy at the peak, the canopy should be laid out on the packing table with the gore having the nameplate uppermost. Take a position on the left-hand side of the table. Then looking along the table toward the hooks at the end, trace No. 1 suspension line to the point where it emerges from the vent of the canopy. Still looking toward the hooks, count out 14 lines, including No. 1, that emerge successively from the vent and are on the right-hand side (looking down the table) of No. 1

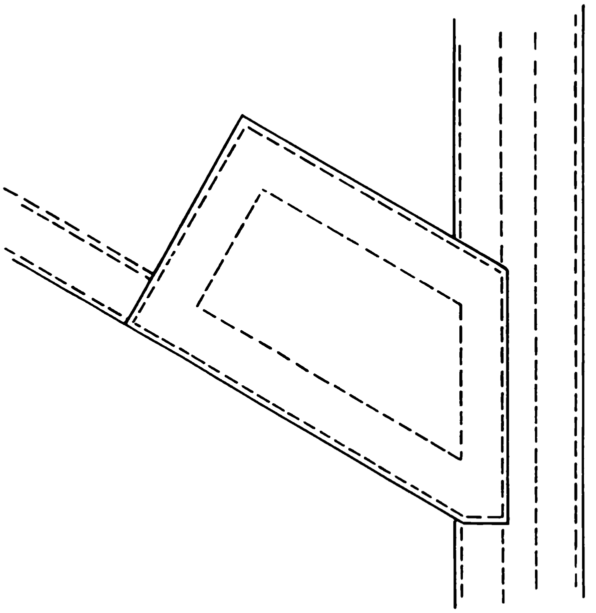


Figure 12-21.—Double patch anchored to seams.

suspension line. This action forms a loop in the suspension lines at the peak of the canopy, and it should be temporarily placed over a hook or toggle to prevent its entanglement. The connector cord is made from a 42-inch length of 1/2-inch tubular nylon webbing. Sear each end of the cord to prevent fraying. Loop one end of the cord through the separated suspension lines and secure with a bowline, having a 4-inch loop. Tie an overhand knot in the bitterend to make the bitter end 1 inch long. Pass the other end through the pilot chute suspension line loop and secure the cord with a bowline knot with a 4 inch loop. After tying an overhand knot, the bitter end will be 2 inches long. The overall length of the cord should be 21 1/2 inches. (See NAF Blueprint 54352.)

RECONDITIONING THE PARACHUTE CONTAINER

Reinforcing the Container

Reconditioning of the container can be accomplished with or without a sewing machine. In no case should any patches, modification, additions, attaching of cushions or life-raft cases, or other repairs of any nature be made to the container while the parachute is packed therein. To do so is to risk the possibility of accidentally securing the suspension lines, pilot chute, or the main canopy to the container and thereby slowing or preventing the release of the parachute in an emergency. Tears and rips in the material should be repaired with a single outside patch turned under a half inch at the edges. Corners and edges of the container chafed by the metal frame should be reinforced with 1,800-pound nylon webbing. Do not use light herringbone tape for this purpose.

At the first appearance of acid stains on a pack, the parachute must be unpacked immediately and the canopy examined for similar damage. The affected portion of the container must be cut out and an outside patch applied, provided the area is not excessively large. The entire container must be replaced if the affected area is too large (consistent with good judgment) or if the stains are numerous. The canopy should be inspected and repaired, if necessary, as previously described.

If the stitches securing the suspension line loops to the false bottom have been broken, the stitching may be replaced, provided the material of the false bottom has not been damaged to the extent that the new stitches will not hold securely. In the latter case, the false bottom must be replaced by a new one. If the tape of the suspension line loops has been torn, it should be replaced by a new tape and must not be patched or mended.

A piece of 1 1/2-inch nylon tape should be cut and sewed to the false bottom so that the distance between the rows of stitches as measured on the false bottom corresponds to the distance between the rows of stitches on the original pack. The length of the tape between adjacent rows of stitches is 2 5/8 inches for 28-foot canopies. When the parachute is being deployed, it is of utmost importance that the suspension lines be permitted to pay out of the loops freely. Consequently in repairing suspension line loops, great care must be exercised to insure that the patches, heavy stitches, loose thread ends, or other obstructions do not prevent free emergence of the suspension lines. If the loops become enlarged to such an extent that they do not firmly hold the suspension lines in place, they must be renewed. Original details of manufacture should be noted and reproduced as closely as possible.

The two short lengths of webbing sewed to the bottom of the container and which secure the pack to the harness frequently rip loose and must be replaced. The container thus damaged does not offer a secure attachment and must be reinforced by a patch placed on the inside of the container. This reinforcement patch should be of like material and be 2 inches longer and 2 inches wider than the webbing.

Replacing Defective Grommets

Defective or missing grommets must be replaced, using special dies. When a grommet has torn out of its fastening, it will be necessary to reinforce the damaged place with a nylon patch or with tape or light webbing, as the case requires, before replacing the grommet. It will be necessary to cut away the torn parts before applying the reinforcement so that the thickness around the grommet will not be increased to such an extent as to prevent the locking pins from passing through the holes in the cones. Care must be taken that the inner edges of the grommets are perfectly smooth and rounded so as not to obstruct the operation of the locking pins or retard the action of the grommets in slipping off the cones.

When cones have become corroded, have bent or broken flanges, or are worn where the grommets or tab ends bear, they must be replaced. In replacing cones on the container, sew with double 3-cord nylon thread. (Note the way other cones are sewed and follow the same sewing pattern.) Be sure the ripcord pinholes in the cones are in line with each other and also in line with the direction of ripcord pull.

In replacing loose or lost eyes, sew with double 3-cord nylon thread. (Note the way the other eyes are stitched and follow the same procedure.) It will be noticed that at each point of stitching, five turns of the doubled thread are used. It does not matter in which order the stitches are made. Finish with the thread on the underside of the container and tie off.

Constructing Parachute Carrying Bag

Parachutes are shipped and stored in cans, however, in transporting packed parachutes or during temporary stowage of unpacked parachutes, a parachute carrying bag may be required.

There will be many opportunities while working in a loft to construct parachute bags. The physical dimensions, layout, and cutting will vary somewhat in each loft. To show illustrations and step-by-step procedure here would be a waste of time as in most every case a parachute bag will be made from a template, available in the loft. After constructing a few bags under supervision of a senior PR, you will have no trouble in making a bag to any size desired. The most difficult part at first will be the installation of the slide fastener, which is covered in chapter 13.

QUIZ

1. The maximum weight of nylon parachute cloth cannot be more than
   a. 1.1 ounces per square foot
   b. 1.1 ounces per square yard
   c. 11.0 ounces per square foot
   d. 11.0 ounces per square yard
2. The minimum tear resistance of nylon parachute cloth for both the warp and the filler thread is____pounds.
   a. 3.5
   b. 35
   c. 40
   d. 80
3. The minimum breaking strength, in pounds, for ripstop nylon parachute cloth is____ pounds.
   a. 20
   b. 35
   c. 40
   d. 80
4. The breaking strength of type I nylon cord is____pounds.
   a. 10
   b. 55
   c. 100
   d. 550
5. Type III nylon cord is used for
   a. the lines of the Martin-Baker pilot chute
   b. tacking the risers of the NC-3 parachute
   c. constructing the suspension lines of the main parachute
   d. making hesitator loops
6. The breaking strength of type III nylon cord is____pounds.
   a. 10
   b. 55
   c. 100
   d. 550
7. Type IV nylon reinforcing tape comes in
   a. 3/4 inch and 1 inch widths
   b. 3/4 inch and 1 1/2 inch widths
   c. 1 inch and 1 1/2 inch widths
   d. 1 inch and 2 inch widths
8. The minimum breaking strength of type II nylon tape is____pounds.
   a. 400
   b. 425
   c. 1000
   d. 1500

9. Probably the most serious damage which can be sustained by parachutes is
    a. damage by oil and grease
    b. immersion in salt water
    c. contamination by acid
    d. damage by mildew
10. The color of litmus paper used to detect acid contamination is
    a. blue
    b. green
    c. red
    d. yellow
11. When testing for acid or alkaline contamination, litmus paper is dampened with
    a. tap water
    b. ammonia
    c. alcohol
    d. distilled water
12. Damage to a parachute by acid is neutralized by
    a. cleaning solvent
    b. a 50 percent solution of liquid ammonia and distilled water
    c. isolating the parachute
    d. naphthalene flakes
13. The portion of the parachute that can sustain the most serious damage by acid is the
    a. main canopy
    b. harness
    c. shroud lines
    d. container
14. The formation and growth of fungi is prevented by the use of
    a. ammonia
    b. naphthalene flakes
    c. distilled water
    d. a solution of ammonia and distilled water
15. A series of stitches joining two or more plies of material or materials is known as
    a. a stitch
    b. a seam
    c. stitching
    d. a hem
16. The symbol for a seam is divided into____ parts.
    a. 2
    b. 3
    c. 4
    d. 5
17. Seam type LSa-2 is composed of
    a. 1 row of stitches
    b. 2 rows of stitches
    c. 3 rows of stitches
    d. 4 rows of stitches
18. The stitch type in Specification 301-SSa-2 is a
    a. basting stitch
    b. superposed seam
    c. chain stitch
    d. lockstitch
19. A single outside patch may be used to patch a hole of
    a. 1/2 inch or less
    b. 1.inch or less
    c. 2 inches or less
    d. 3 inches or less
20. A patch not anchored to a seam or hem must be backstitched
    a. 1 inch
    b. 1 1/4 inches
    c. 1 1/2 inches
    d. 2 1/2 inches
21. When using a double patch on a canopy, the inside patch is sewn with
    a. 1 row of stitches, 1/16 inch from edge of patch
    b. 2 rows of stitches, 3/8 inch apart
    c. 2 rows of stitches, 3/8 inch apart, first row 1/16 inch from the edge of the patch
    d. baseball stitches
22. The raw edges of a patch are turned under ____inch.
    a. 3/8
    b. 1/2
    c. 3/4
    d. 1
23. When applying a double patch to a canopy, the outside patch is
    a. 1/4 inch smaller than the inside patch
    b. 1/4 inch larger than the inside patch
    c. 1/2 inch larger than the inside patch
    d. the same size as the inside patch
24. If a hole exceeds 8 inches at its widest dimension it must
    a. have a double patch
    b. be considered a major repair
    c. have a single patch
    d. be patched if the patch can be anchored to a radial seam or a diagonal seam
25. A harness with defective stitching in the lift web to link sewing should be
    a. repaired
    b. repaired if only 7 or 8 stitches are defective
    c. repaired after reviewing applicable technical publications
    d. replaced by a new or serviceable harness

CHAPTER 13

FASTENERS

Fasteners are designed for every need and purpose in the textile industry. Fasteners of various sizes, shapes, and descriptions are serviced by the Parachute Rigger. Some are small, some are large, some are complicated. All serve the same purpose; they hold things together, either permanently or temporarily.

Certain fasteners are designed to hold with tenacity, while another fastener similar in appearance will release its grip easily. Others will release only if pulled or pried in a certain direction. Permanent type fasteners act as anchoring and reinforcing points for pockets and corners, and innumerable other purposes.

The Parachute Rigger must be able to set, repair, and renew the following fasteners, or take the proper corrective action:

Snap fasteners
Grommets
Speedy rivets
Slide fasteners

SNAP FASTENERS

Snap fasteners most commonly used in the manufacture of parachutes and for general utility work are described in the following paragraphs.

Wire Spring Clamp Type Fasteners

The wire spring clamp type fastener is furnished in two sizes, regular (NAF 312320) and small (NAF 312321). In the parachute loft the wire spring clamp fastener is popularly called DURABLE DOT or DURA DOT. Figure 13-1 shows the parts of the regular wire spring clamp type fastener. In comparison to the regular size, the button of the small wire spring clamp type fastener has a dimension of 17/32 inch, with corresponding smaller parts.

The regular and the small wire spring clamp type fasteners are designed with a strong grip, and they will release or separate when pulled in any direction. The regular size wire spring clamp is the one most frequently used. It is used in the manufacture of back pads and parachute packs. It is also used on flight clothing where the additional security offered by the "three-way snap" is not needed. NAF blueprints refer to the parts of this fastener as button, socket, stud, and eyelet.

All parts are plated. Notice the difference in the studs in figure 13-1. These studs make it possible to mount the fastener in fabric, wood, or metal.

Three-Way Locking Snap Type Fasteners (NAF 312326)

Figure 13-2 illustrates the parts of this fastener which is manufactured in only one size.

It is used on flight clothing, parachute packs, and back pads. Since this fastener will open only when pulled in a certain direction, it is not used in conjunction with any quick opening keepers or other devices connected with the functioning of a parachute. For example, the lift web keepers of a seat type parachute are equipped with the REGULAR WIRE SPRING CLAMP FASTENER designed for quick release. However, the two vertical keepers which hold the shoulder straps and the back strap are fitted with THREE-WAY LOCKING SNAPS. (Do not confuse the two different fasteners.)

Curtain Type Fasteners (NAF 49955)

The curtain type fastener (lift-the-dot) is manufactured in two sizes, large and small. The parts of the large lift-the-dot, with various types of studs, are shown in figure 13-3. These fasteners have many uses, especially for truck and boat covers. The small lift-the-dot is used for lighter work.

Glove Snap Type Fastener (NAF 312322)

Figure 13-4 illustrates this type fastener, which is generally used on lightweight flight clothing.

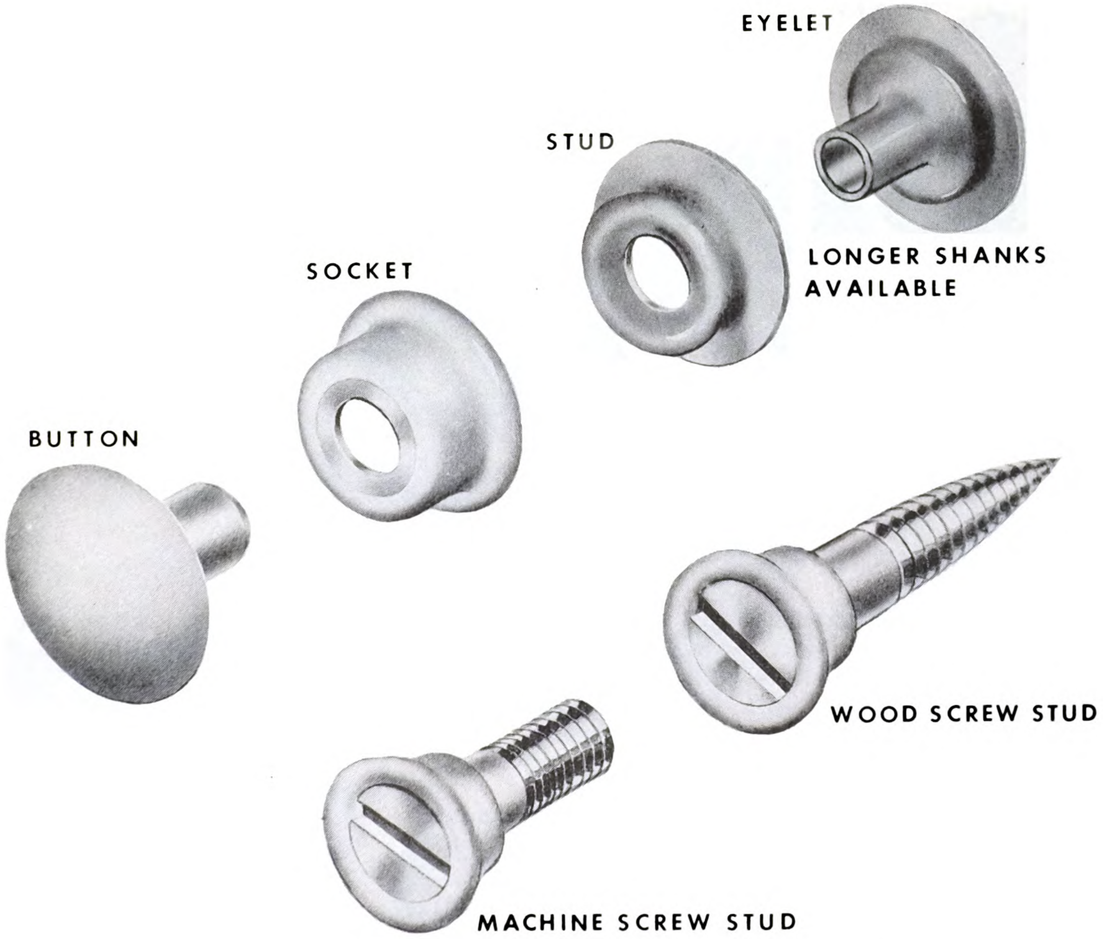


Figure 13-1.—Regular wire spring clamp type fastener.

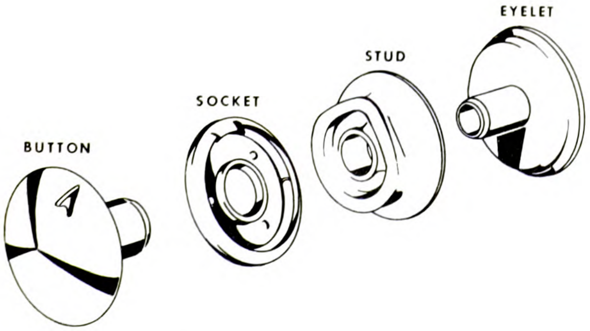


Figure 13-2.—Three-way locking snap type fastener.

Installation of Snap Fasteners

Figures 13-5 through 13-7 illustrate the method and tools employed in setting the regular wire spring clamp type fastener, large curtain type fastener, and the glove snap type fastener.

Setting Tools

In order to properly install the various types of fasteners used in the loft, it is essential to use the proper tool (chucks and dies) for the fastener being installed.

A fastener kit which consists of a small cabinet, five drawers, and a supply of assorted fasteners and setting tools is contained in the *Federal Stock Catalog* — Group 53 — Part 8.

The fasteners are replenishable out of ASO stock, but the chucks and dies are not replenishable. When a chuck or die is lost or damaged, it requires an Open Purchase Order to replace it.

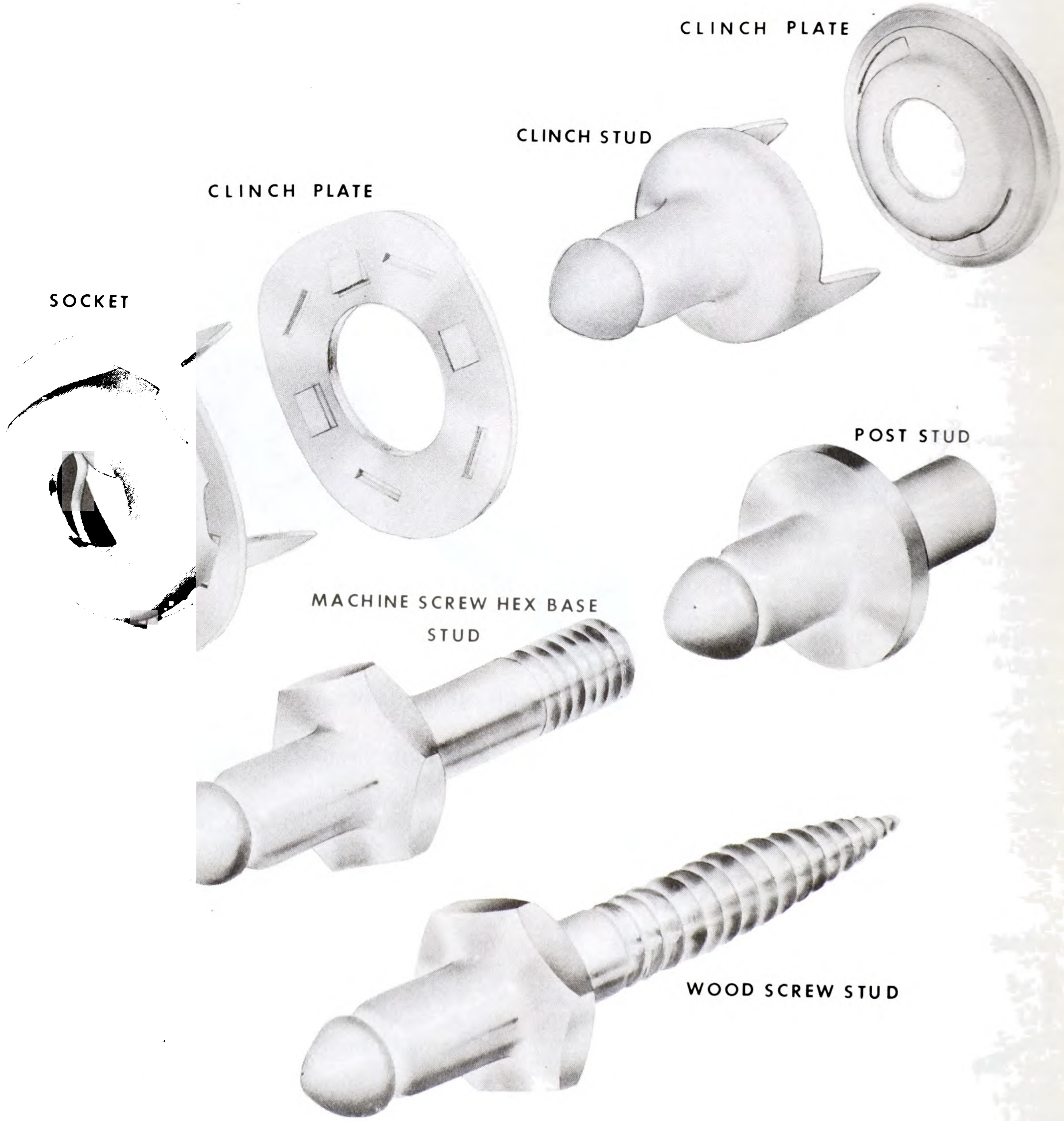


Figure 13-3.—Large curtain type fastener (lift-the-dot).

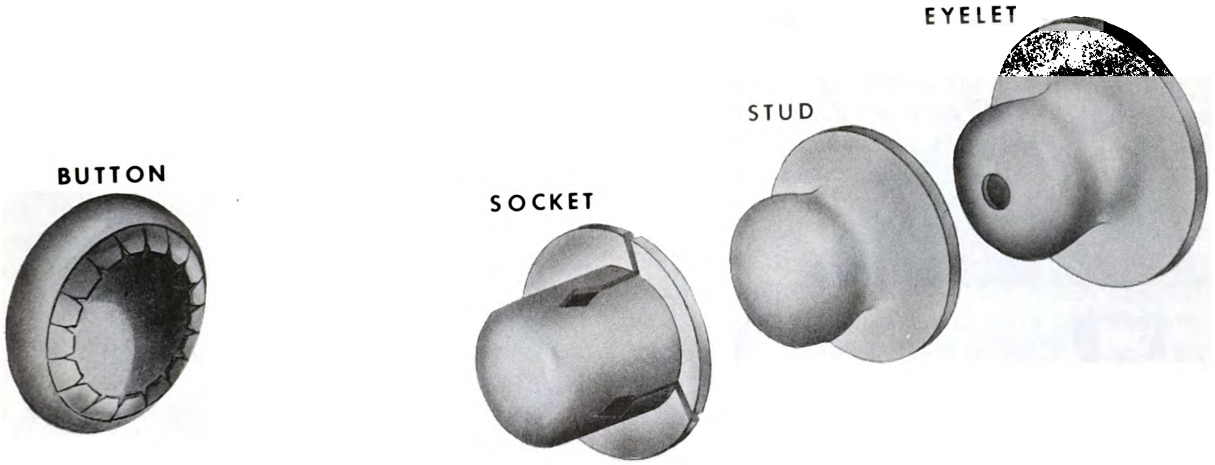


Figure 13-4.—Glove snap type fastener.

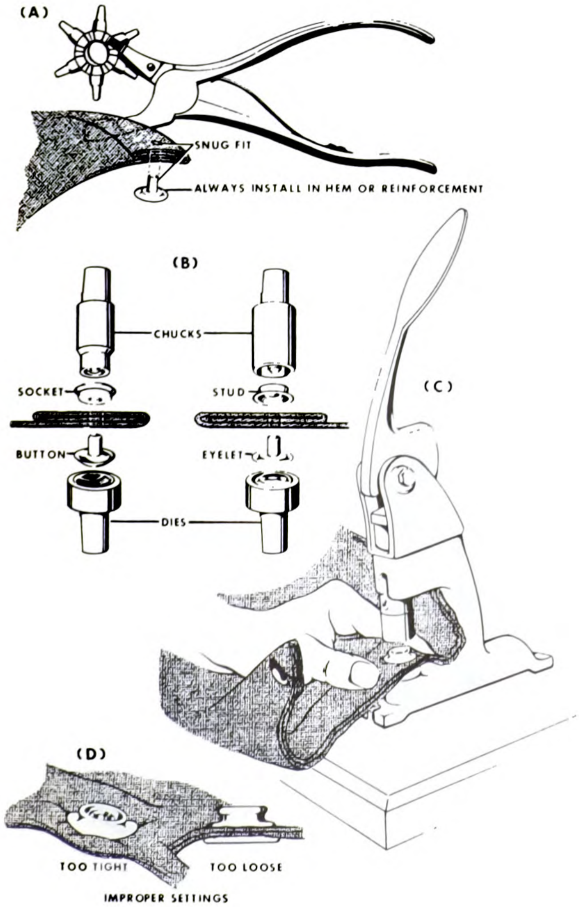


Figure 13-5.—Steps in installing the regular wire spring clamp type fastener.

Figure 13-8 illustrates the fastener kit and setting tools available for the snap type fasteners. Figure 13-9 illustrates the hand and foot presses used to set snaps, speedy rivets, and grommets. The revolving belt (eyelet) punch is used to make small holes of varying sizes in preparation for setting some fasteners.

GROMMETS

The grommet serves as a reinforcement around a hole or cut. It can be round, square, or oblong; and it can be made from metal, rubber, or fabric. The type used for parachutes is round and made of metal.

The grommet used in parachute pack side flaps is a plain unit of special size and contour and requires special dies to set it. Today these grommets are set under a process which fuses the edge of the hole in the material and prevents the circular cut from fraying. (See fig. 13-10.)

Figure 13-11 illustrates the sizes and shapes of plain and spur grommets. Design specifications may be found in Air Force-Navy Aeronautical Standard Drawing AN 230.

Whenever possible, the material should be reinforced with a hem or patch before installing a grommet. The spur grommet is designed for heavy work and stress and should not be used on lightweight fabrics.

Figure 13-12 shows the hand and foot press dies and chucks used to set a plain or spur grommet. Figure 13-13 illustrates the steps used in installing either a plain or spur grommet.

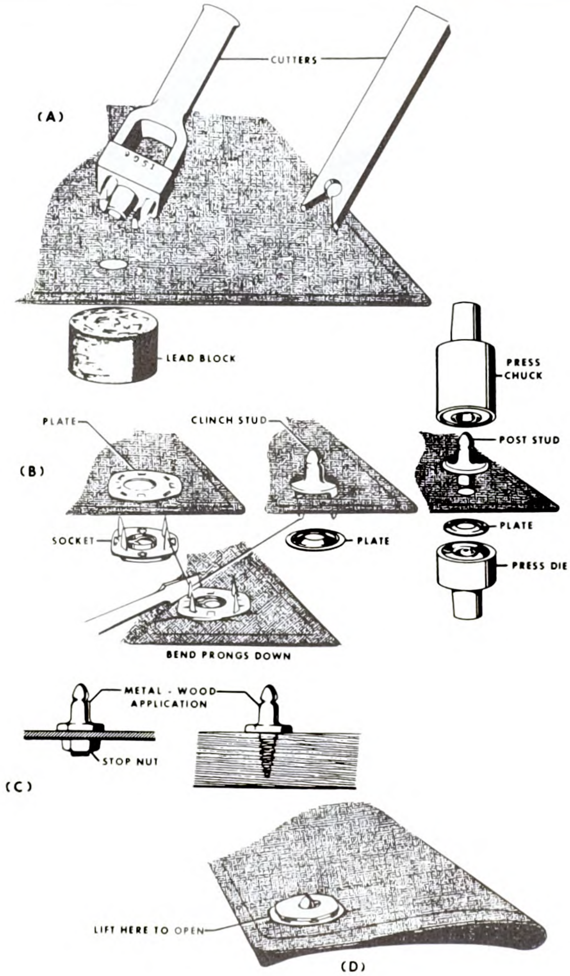


Figure 13-6.—Steps in installing the large curtain type fastener.

SPEEDY RIVETS

Speedy rivets may supplement stitching as an additional reinforcement. One very popular use is in the open corners or pockets of certain clothing. They can also be used to secure a loop in a leather belt or to join two pieces of fabric. Figure 13-14 illustrates two speedy rivet sizes and the method of setting them.

REMOVING FAULTY FASTENERS

Snap Fasteners

A damaged snap fastener is removed by cutting the shank or post securing the socket of one half and the stud of the other half. A sharp pair of diagonal cutting pliers or end cutters will do the job easily; but considerable care must be taken not to cut the fabric between the crimped shanks or extensions. Figure 13-15 illustrates a correct method of removing a faulty fastener.

Some Parachute Riggers prefer to drill the fasteners out, and in some cases this is the better method. When the material is brittle and easily damaged, a drill will do the job more safely. However, one must take care to secure the fastener so it will not turn and tear the hole.

Removing Grommets

Grommets can be removed by prying the shank away from the washer until the shank is uncrimped enough to permit the washer to be withdrawn.

Removing Speedy Rivets

Use a pair of diagonal cutting pliers to remove a speedy rivet. Cut the crimped shank half way between the two parts while taking care not to damage the fabric.

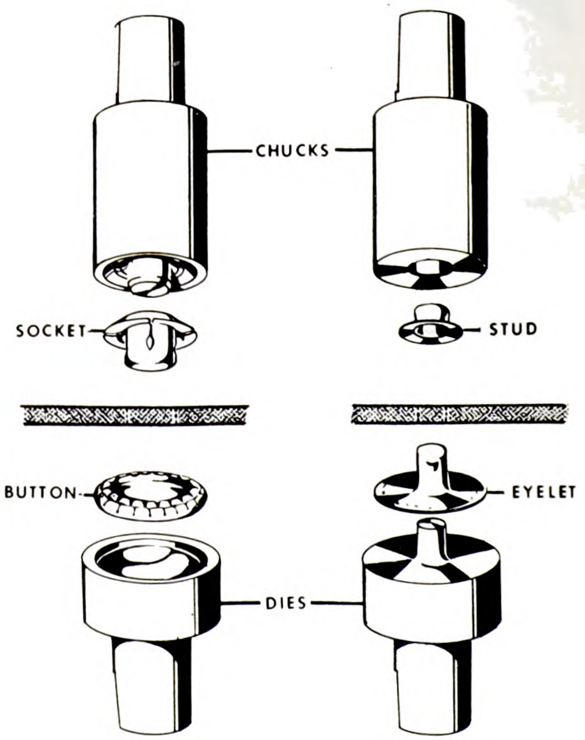


Figure 13-7.—Steps in installing the glove snap type fastener.

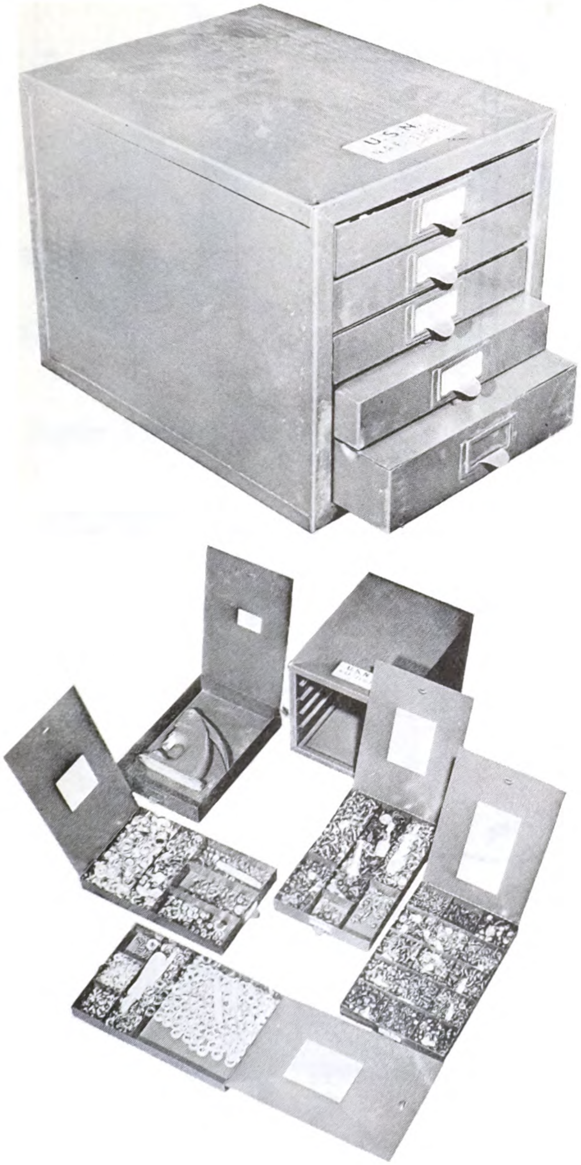


Figure 13-8.—Fastener kit.

SLIDE FASTENERS

The types of slide fasteners (zippers) used on flight clothing and other items of aviation equipment are shown in figure 13-16.

Slide Fastener Construction

A slide fastener is comparatively simple in construction, but sometimes proves troublesome. The various parts of slide fasteners are identified in figure 13-17 and 13-18 so that no difficulty will be experienced in their operation and installation.

A slide fastener consists of two rows of teeth (hollow cones or scoops) facing each other. When brought together at the proper angle, each tooth is designed to fit within the tooth opposite.

When closed, the slide fastener teeth cannot be parted except through use of the SLIDER which, when moved, displaces the teeth at the proper angle for meshing and unmeshing.

The small clips at the top and bottom of slide fasteners are designed to keep the slider from running off the track. Certain types of fasteners are equipped with a small retainer and pin arrangement on the bottom to permit the fastener to separate.

Slide Fastener Operation

Ordinary slide fasteners are designed for flat, smooth operation, and both hands are required for proper functioning. The chain should be stretched taut with one hand and the slider worked (without force) with the other.

If a garment is composed of soft nappy material or lined with wool or fur, the slide fastener should be operated with great care to prevent jamming the slider.

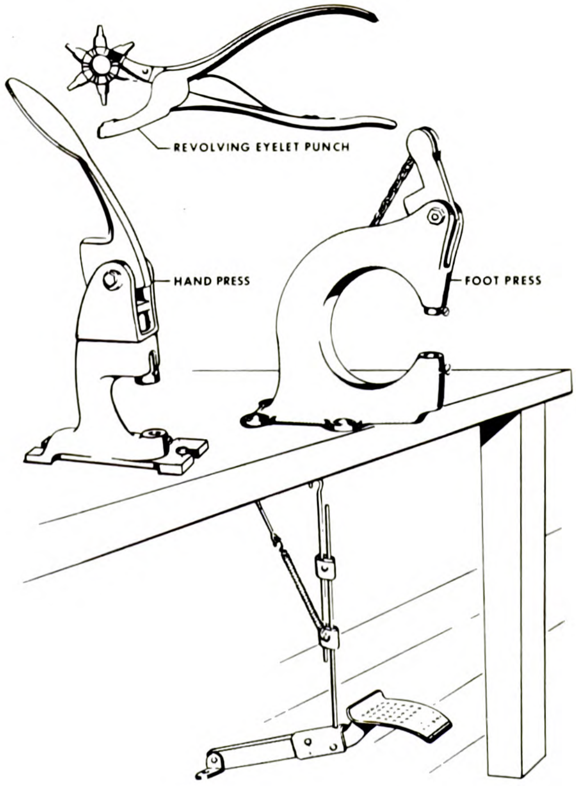


Figure 13-9.—Hand and foot presses.

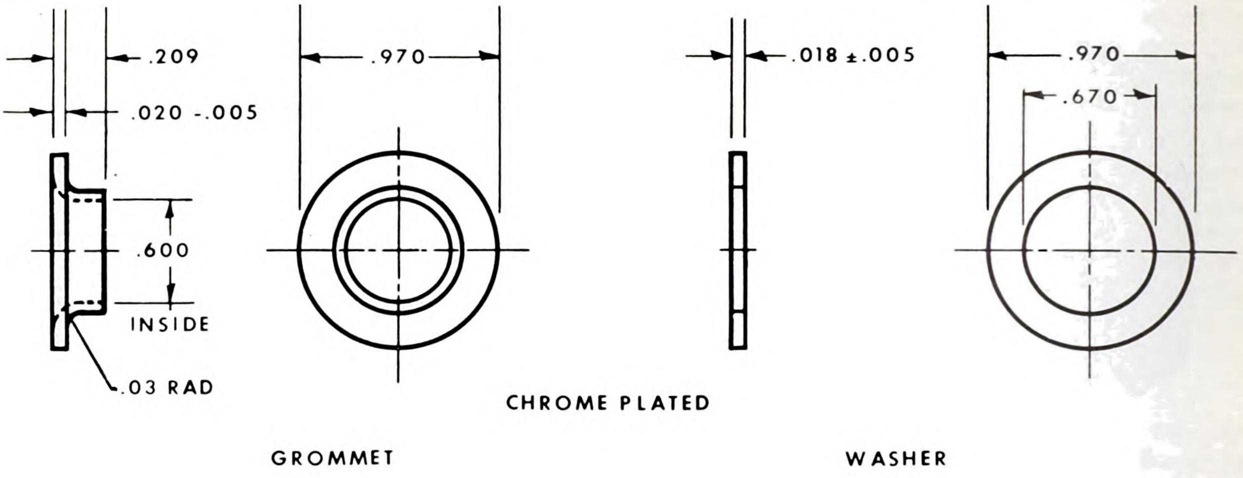


Figure 13-10.—Grommet and washer used on parachute container.

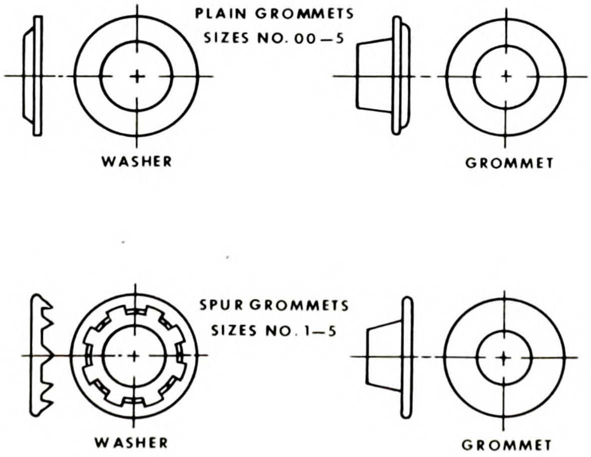


Figure 13-11.—Grommets, plain and spur.

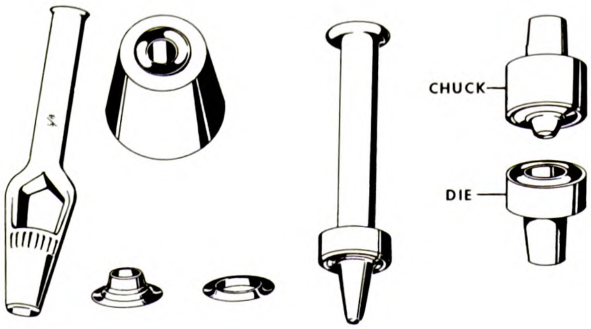


Figure 13-12.—Grommet setting tools.

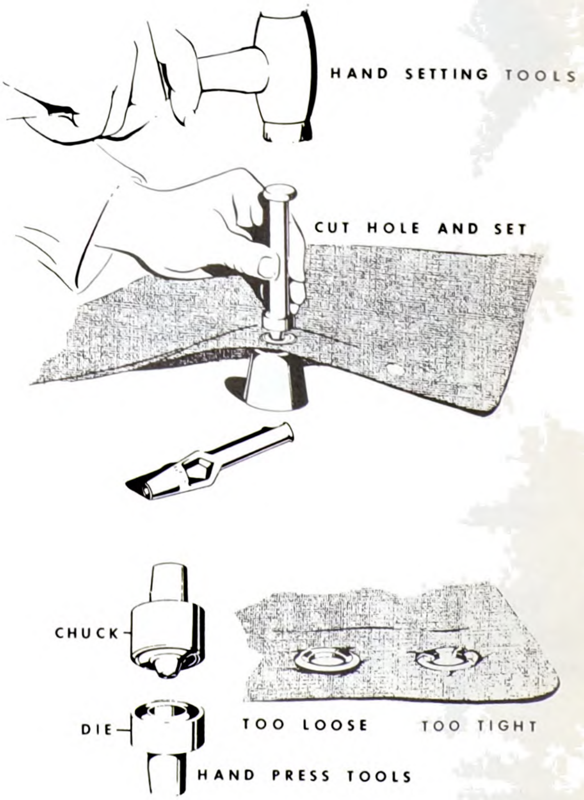


Figure 13-13.—Steps in installing a grommet.

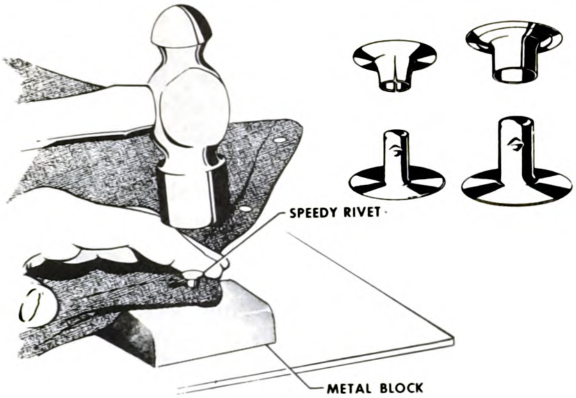


Figure 13-14.—Setting the speedy rivet.

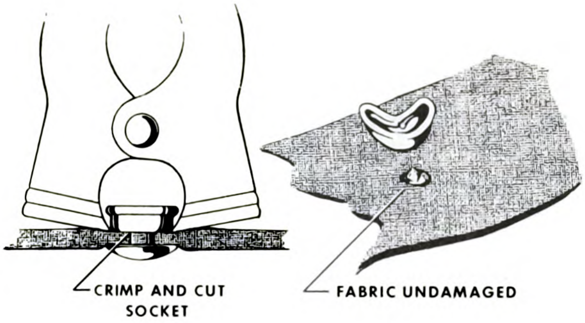
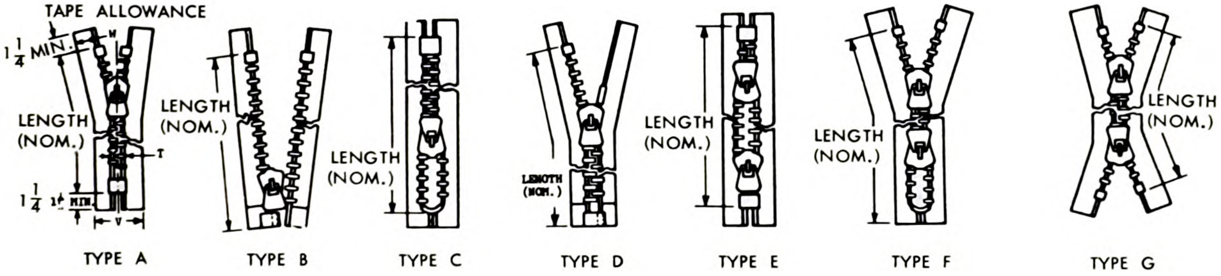


Figure 13-15.—Removing faulty snap fasteners.



TYPE A - NON-SEPARATING, SINGLE ACTION.
TYPE B - SEPARATING, SINGLE ACTION.
TYPE C - NON-SEPARATING, SINGLE ACTION WITH BRIDGE STOP.
TYPE D - SEPARATING, SINGLE ACTION, QUICK DETACHING.
TYPE E - NON-SEPARATING, DOUBLE ACTION, CENTER OPENING.
TYPE F - NON-SEPARATING, DOUBLE ACTION WITH BRIDGE STOP.
TYPE G - SEPARATING, DOUBLE ACTION, END OPENING.

SIZE 0 - LIGHT SERVICE.
SIZE 1 - LIGHT-MEDIUM SERVICE.
SIZE 2 - MEDIUM SERVICE.
SIZE 3 - MEDIUM HEAVY SERVICE.
SIZE 4 - HEAVY SERVICE.

STYLE S - STANDARD NON-LOCKING.
STYLE L - LOCKING.

Figure 13-16.—Slide fasteners, interlocking.

Grease or oil often lodge between the tiny hollow parts of the teeth and accumulate dirt and lint. This causes stiff operation of the slider.

A casual inspection will determine whether a slider is the locking type. Always be certain that the pull tab is lifted at right angles to the slider before attempting to move the latter. Figure 13-19 shows the relative positions of the pull tab.

Slide Fastener Tools

In addition to common tools such as screwdrivers, pliers, awls, knives, scissors, and needles, a well-equipped slide fastener kit should be included in loft equipment.

Four slide fastener-kit tools illustrated in figure 13-20 are the pull-up pliers, nippers, stop-closing pliers, and bent-tip awl.

End cutters or nippers are used for removing or cutting off stops and teeth. Stop-closing pliers are designed to span over the slider and clamp the stops in position. An awl with a bent tip is a handy implement for closing the teeth by hand.

Slide Fastener Repair

A torn or ripped cord cannot be patched, but should be replaced with a complete new slide fastener. If the cord is damaged near the top or bottom of the fastener, and the injured ends can be cut off to shorten the slide fastener without

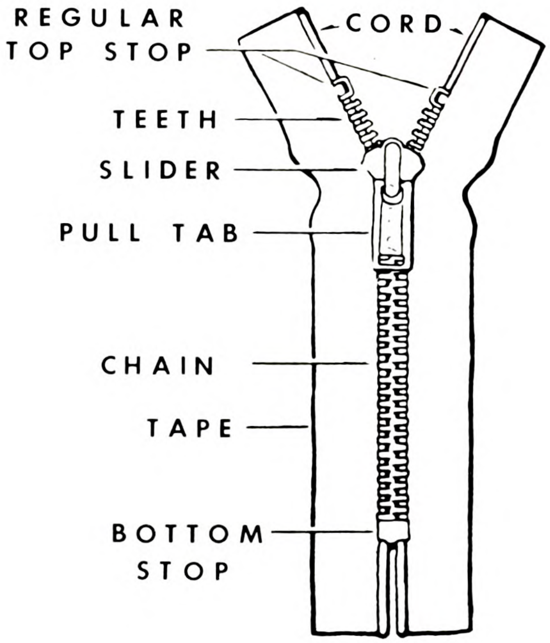


Figure 13-17.—Slide fastener, regular type.

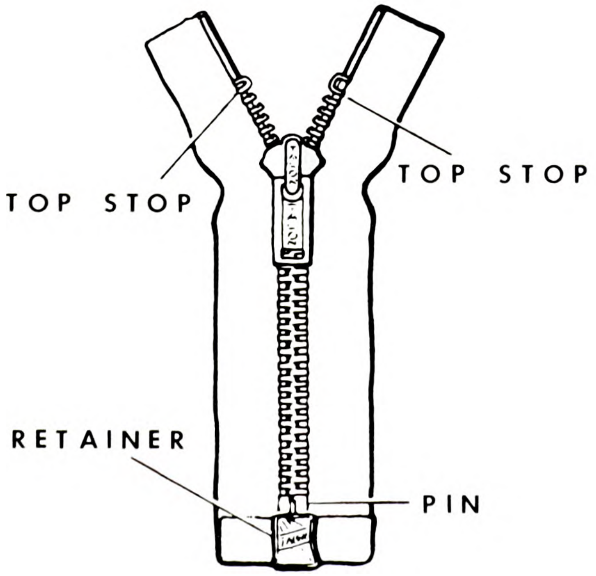


Figure 13-18.—Slide fastener, separating type.

hampering the usefulness of the garment, an effective repair can be made.

Loose or missing teeth and stops will cause trouble. If teeth or stops are not tightened, they will eventually be lost and tear the cord. In repairing such damage, see that the loose stop nearly touches the teeth, then squeeze tightly with pliers. Set the loose teeth parallel with those adjacent, and apply pressure with pliers. If a replacement stop is not available, it can be replaced with soft wire. Heavy thread may be substituted for the wire.

It is the best policy to replace a complete slide fastener when there is a tooth missing. If there are no spare slide fasteners available, a missing tooth can be replaced. This is accomplished by carefully removing two opposite teeth from the bottom or top of the chain. Use one of the teeth as a replacement. Move the stops until they nearly touch the teeth, then tighten. This will keep both sides of the chain the same length.

Difficulty in moving the slider may be caused by the jaws of the slider being too tight. Insert a screwdriver between the jaws and very gently pry them apart until free operation is effected. If teeth are gummed with oil or grease, wipe or scrub the chain with a piece of rough material,

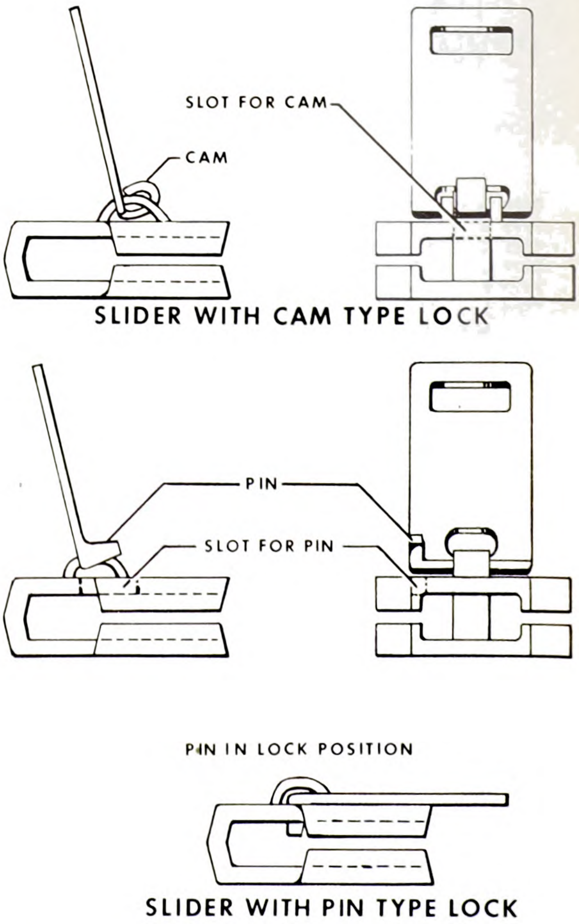


Figure 13-19.—Slide fastener pull tabs.

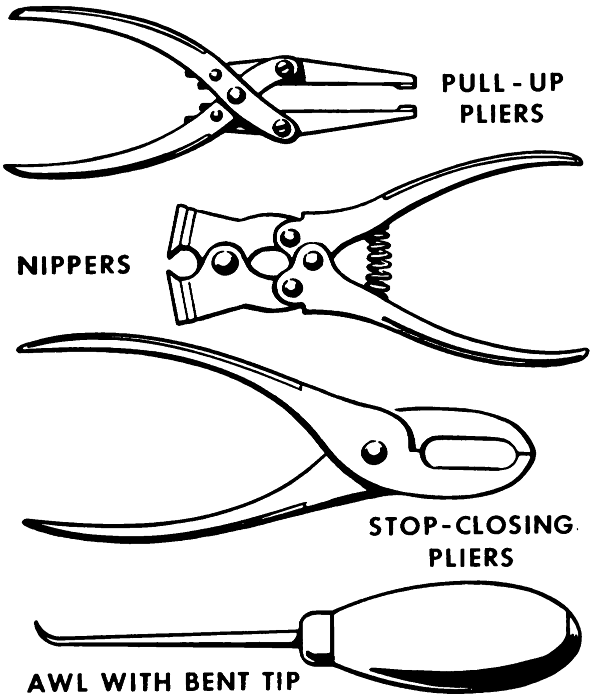


Figure 13-20.—Slide fastener tools.

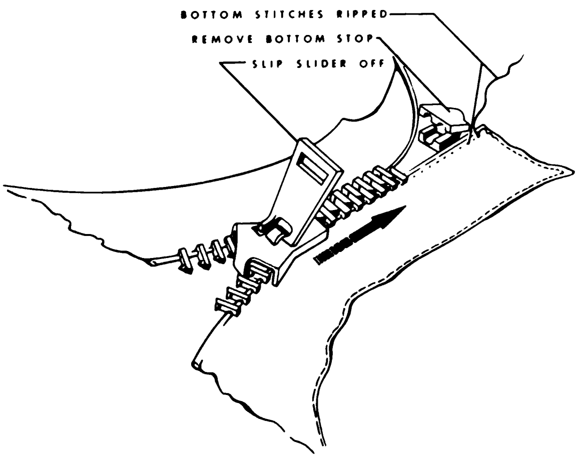


Figure 13-21.—Removing the slider.

an old toothbrush, or even a pipe-cleaner saturated with a cleaning fluid. To lubricate the chain, apply one drop of oil or a pinch of graphite between thumb and forefinger and run the chain up and down between the fingers.

Should the slider become jammed with fur, wool, or other material, carefully remove such matter with a pin or needle while gently pulling the slider until it is released. If it is so badly jammed that it resists all efforts, remove the slider by carefully bending the jaws apart and returning the jaws to their original position, then replace the slider on the chain, as described later.

The majority of pull tabs have two small projections fitting into slots on each side of the slider. To remove the pull tab, use two pairs of pliers, one on each side, and twist in opposite directions. In replacing pull tabs, this procedure is reversed. Pull tabs furnished as replacements need only to be squeezed onto the slider.

A smashed slider may be removed by inserting two small screwdrivers, one on each side of the chain, to force the jaws apart.

Most slide fastener trouble may be traced to a bent slider in which the jaws are either spread too far apart or too close together, instead of being parallel. The proper procedure for removing and replacing a slider on the chain following repair is explained in the following paragraphs.

To remove the slider from the REGULAR TYPE SLIDE FASTENER, carefully rip the stitches from the BOTTOM of the slide fastener to expose the ends of the tape. Then remove the bottom stop and slip the slider off the bottom of the chain and entirely off the cords and tape, as shown in figure 13-21. If repair is impossible due to a severed cord, discard the slide fastener in favor of a new one.

To replace the slider on a regular type slide fastener, thread the two bottom cords into the wide end of the slider. Hold the tape so that the bottom teeth are correctly matched as shown in figure 13-22. Then draw the slider upward until the teeth mesh for several inches. Without allowing the teeth to separate, clamp the bottom stop close to the teeth and over both cords as shown in figure 13-23. Replace the tape ends and ripped stitches by hand or machine.

To remove a damaged slider on a SEPARATING TYPE SLIDE FASTENER, carefully rip the stitches at the TOP of the slide fastener, on the retainer side only, thus exposing the end of the tape. Remove the top stop, slip the slider off the top of the chain, and completely remove it from the cord and tape. Repair or replace the slider.

To replace the slider on a separating type slide fastener, thread the retainer side cord into the narrow end of the slider, and allow the slider to slip down the chain. Replace the tape end and ripped stitches by hand or machine. (See fig. 13-24.)

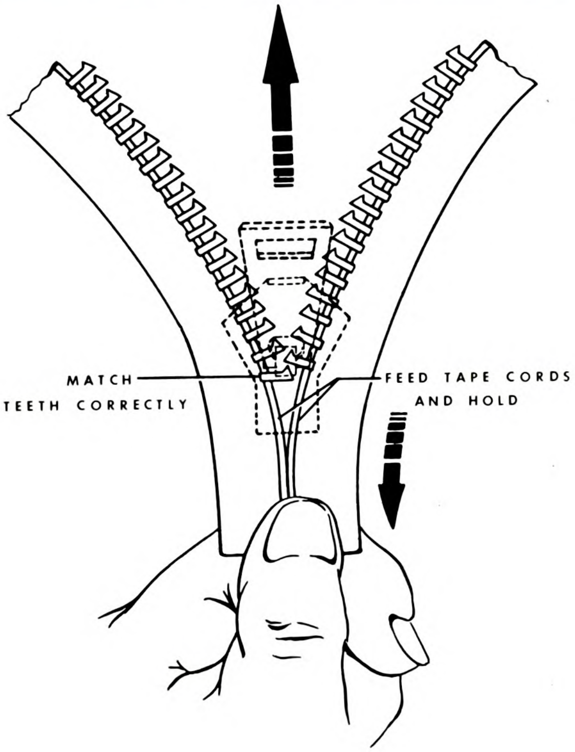


Figure 13-22.—Matching the slide fastener teeth.

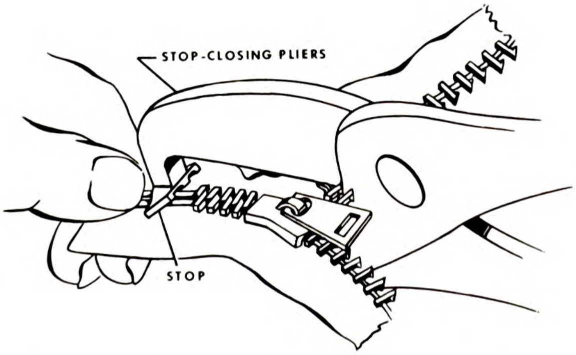


Figure 13-23.—Crimping the bottom stop.

To replace the slider on the top of a regular type slide fastener with the aid of pull-up pliers, slip the tool over the bottom stop, clamp together, and pull upward as shown in figure 13-25. Close the entire chain in this manner. Thread the two top cords into the narrow end of the slider, holding the teeth meshed until they enter the slider. Replace the top stops, tape ends, and ripped stitches by hand or machine.

SHORTENING A SLIDE FASTENER

To shorten a slide fastener, first determine the length required. The chain should be about 1/2 inch shorter than the opening in the material or garment. Mark the desired length, measuring from the bottom stop upward. (See fig. 13-26.)

Open the chain to any point below this mark, as shown in figure 13-27.

Cut directly across the tape about 1 inch above the mark. Then cut off the teeth from the mark to the end of the tape as illustrated in figure 13-28. Cut an equal number of teeth from each side of the chain.

Replace the two stops, crimping firmly.

Installing a Slide Fastener

The installation of a slide fastener will vary with the type of job. Some will be curved, some around corners, some hidden. The installation of a straight slide fastener is illustrated in the following paragraphs.

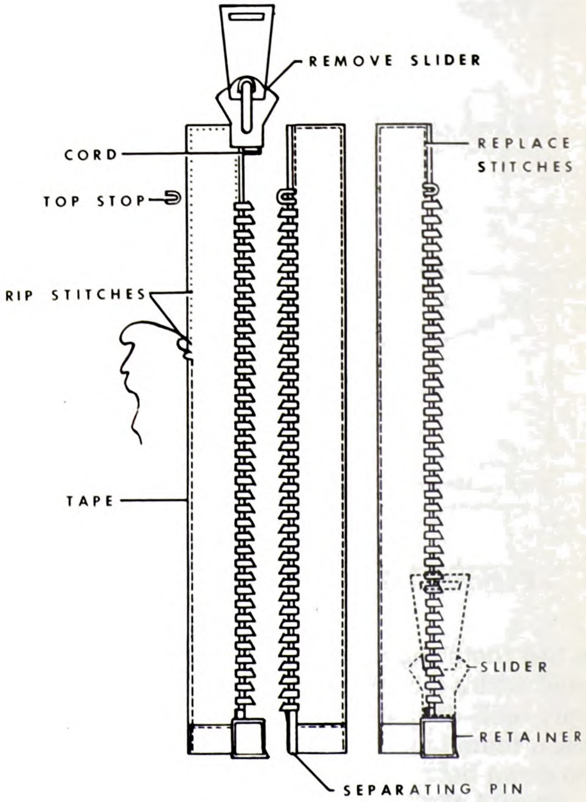


Figure 13-24.—Changing a slider on a separating type slide fastener.

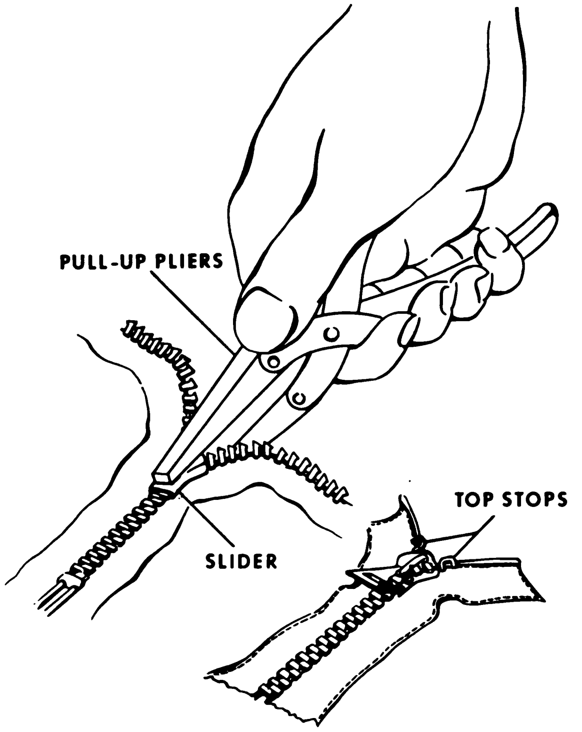


Figure 13-25.—Closing slide fastener with pull-up pliers.

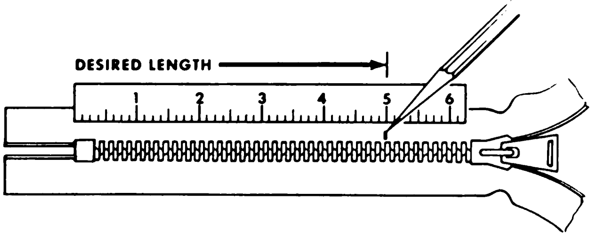


Figure 13-26.—Measuring and marking desired length of slide fastener.

SLIDE FASTENER PRESSER FOOT

In order to install a slide fastener neater and easier, a slide fastener presser foot should be used on the sewing machine. The slide fastener presser foot will serve not only as a guide for a neat row of stitches, but will also prevent the foot from riding up on the chain.

The sewing machine manufacturer can supply a regular slide fastener presser foot (right or left) for any sewing machine, or one can be made locally. File or grind the left side of an old presser foot to permit sewing to within 1/8 inch of the chain.

FABRICATION

When sewing, always stretch the slide fastener and not the material, as this makes a flatter and neater job.

A simple method of installing a slide fastener when making a bag or cover with two closed ends follows: Lay the piece of material right side down, and place the slide fastener right side down on top of the material where the opening is to be located. Sew a row of stitches completely around the outer edges of the tape as shown in figure 13-29.

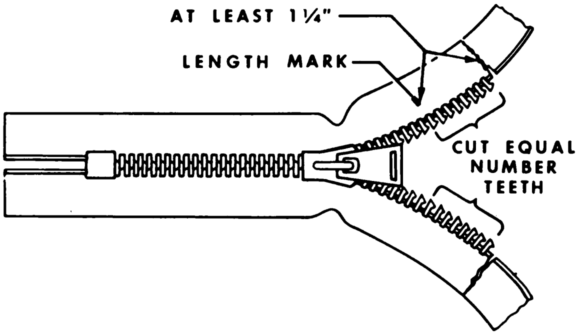


Figure 13-27.—Opening the chain and cutting the tape.

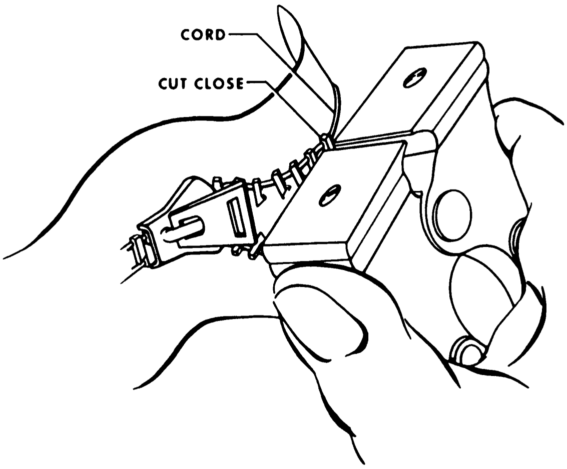


Figure 13-28.—Cutting off the teeth.

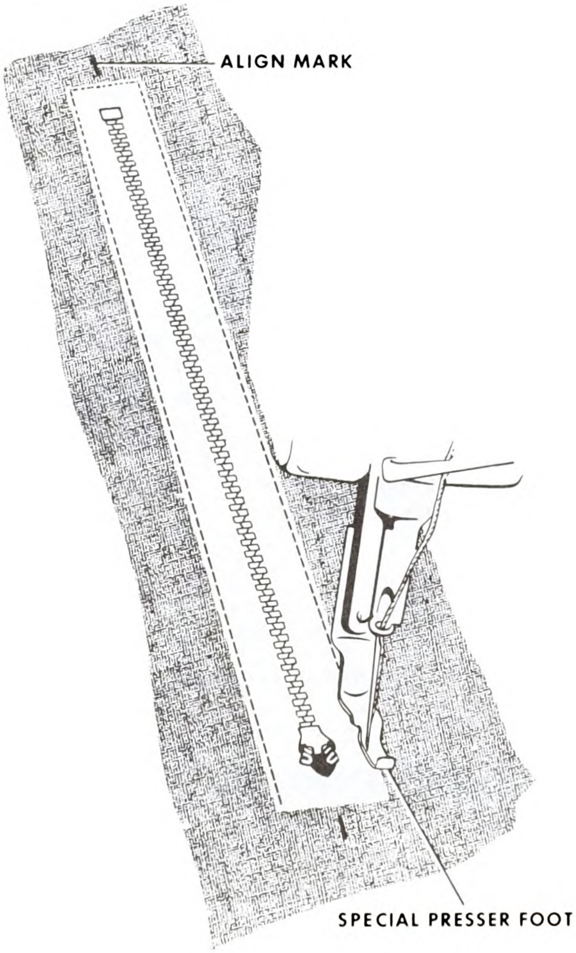


Figure 13-29.—Installation of a slide fastener. Step 1.

Turn the material over. Then by feeling with the points of a scissors, cut directly down the center of the chain and snip a V at each end, as shown in figure 13-30.

Turn the edges of the material under, thus exposing the chain. Allow sufficient space so that the slider will not rub the edge of the hems. The V at each end will permit the sewing of neat, square corners. (See fig. 13-31.)

Procurement of Slide Fasteners

The nonseparating slide fastener tape chain is stocked in bulk rolls of 10-foot minimum lengths in sizes "1" and "3." They are interlocked while carried in stock and will remain interlocked when shipped. The unit of issue is in feet.

The separating slide fasteners (with retainers and separating pins attached) are stocked in size "3" only, and in lengths of 24, 48, 72, and 108 inches. Unit of issue is EACH. Necessary stops and sliders are stocked in bulk. Only the style "L" locking, nonreversible, single pull slider is furnished.

Size "1" medium service and size "3" extra heavy service fasteners are the only two sizes in stock.

Activities should specify the brand of chain for which stops and sliders are required. (Talon, Crown, or any other make.)

Slide fasteners in stock will be supplied in the nearest length ordered. When received, the chain should be cut to the desired length; stops can be salvaged and reused on the cut chain.

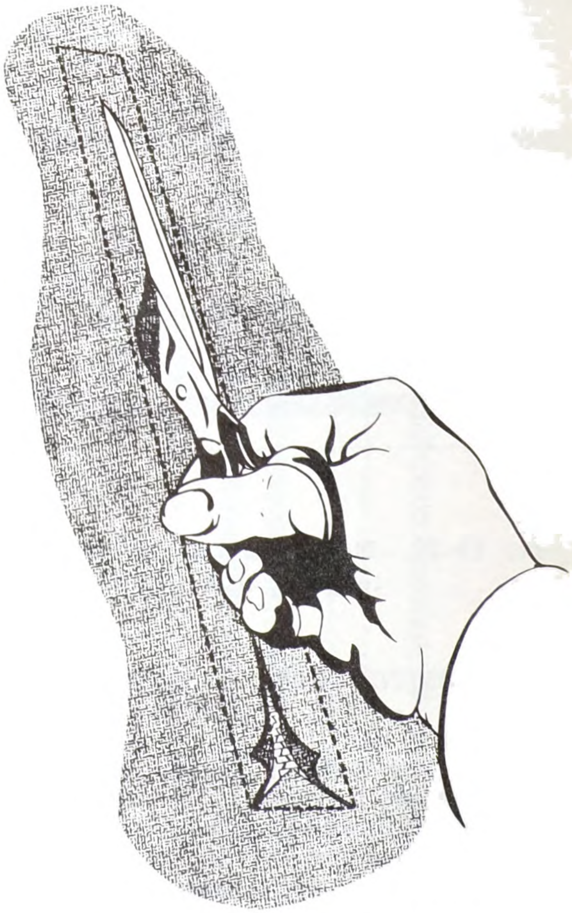


Figure 13-30.—Installation of a slide fastener. Step 2.

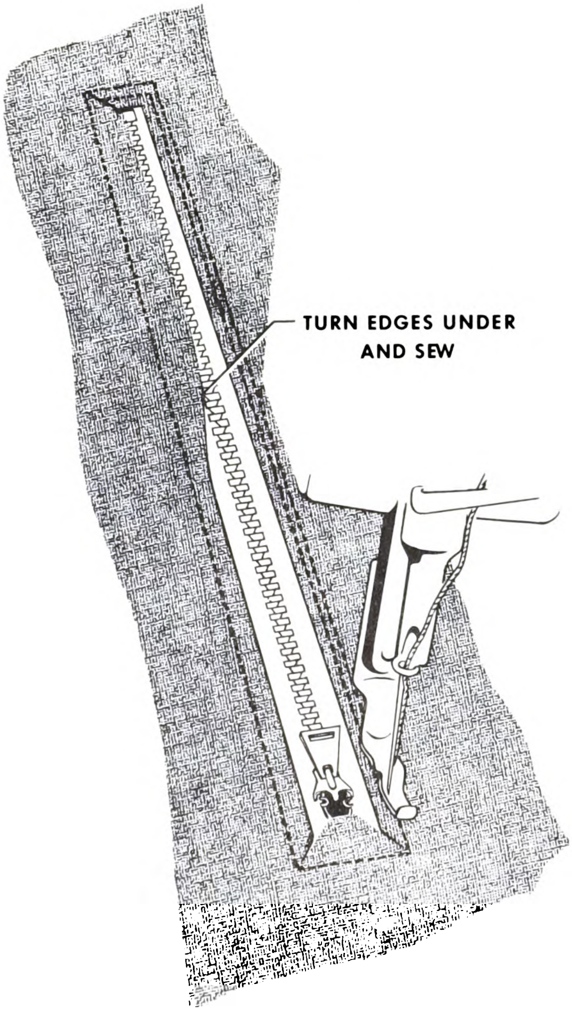

TURN EDGES UNDER AND SEW

Figure 13-31.—Installation of a slide fastener. Step 3.

QUIZ

1. The Parachute Rigger must be able to set, repair, and renew what type of fasteners?
    a. Snap fasteners
    b. Grommets and speedy rivets
    c. Slide fasteners
    d. All the above

2. The three-way locking type snap fastener is manufacutured in how many sizes?
    a. 4
    b. 1
    c. 3
    d. 5

3. When a chuck or die is damaged or lost, how is it replaced?
   a. Order from ASO stock
   b. Open Purchase Order
   c. Section 6 Allowance List
   d. FASRons

4. The spur grommet should not be used on
   a. bunk bottoms
   b. canvas
   c. rubberized fabric
   d. lightweight fabrics

5. Speedy rivets are available in ___ size(s).
   a. 4
   b. 3
   c. 1
   d. 2

6. Most slide fastener trouble may be traced to a
   a. bent slider
   b. top stops missing
   c. bottom stops missing
   d. torn beading

7. The unit of issue for nonseparating slide fasteners is
   a. each
   b. inches
   c. bulk rolls of 10-foot minimum
   d. feet

8. The unit of issue for a separating slide fastener is
   a. feet
   b. inches
   c. each
   d. bulk

9. Separating type slide fasteners are stocked only in size
   a. 4
   b. 2
   c. 1
   d. 3

10. What tool can be used to close a slide fastener?
    a. Nippers
    b. Bent awl
    c. Stop closing pliers
    d. Pull-up pliers

CHAPTER 14

PROTECTIVE HELMETS AND OXYGEN MASKS

Protective Helmets

Protective helmets are to be worn at all times during flight by pilots and aircrewmen in all types of aircraft. Helmets are constructed to distribute impact forces over the entire head and to absorb these forces so that a minimum of shock reaches the skull and brain.

Helmets have long been accepted items for head protection in athletics and certain hazardous industries. They have also been in long use in naval aviation. In early days, aviation helmets were of the same type as motorcyclist's helmets, designed primarily to give protection against windblast. Later, they were made similar to football helmets with the idea of protecting against impact. However, with advances in aircraft design and speed, the need grew for helmets that would simultaneously provide many types of protection. The advent of high-speed jet aircraft, in particular, emphasized the importance of protective helmets that would effectively reduce the danger of concussion or unconsciousness in flight as well as in crash, or seat ejection.

One of the main differences between the aircraft protective helmet and athletic type helmets is in the constituent materials. The aircraft helmet is designed more for absorbing energy than for deflecting energy. Thus, in case of a very heavy blow, the helmet will absorb much of the force of this blow by partial destruction of the material of the helmet rather than by passing the force on to the head. This is often important in preventing serious or fatal head injuries, as demonstrated in a number of cases in which the great forces involved damaged the helmets but left the wearers without serious injury. Another way in which the helmet prevents or reduces injury is by spreading the force of the blow over a large area of the skull instead of letting it be concentrated at the point of impact.

TYPE H-3 PROTECTIVE HELMET

Description

The H-3 protective helmet consists of a cloth underhelmet (liner) and a rigid protective shell. As shown in figure 14-1, the liner fits snugly, provides an attachment for the oxygen mask, and includes a set of radio communication earphones.

Figure 14-2 shows an inside view of the protective shell. Figure 14-3 illustrates the fully equipped H-3 protective helmet assembly.

Construction

The liner is available in five sizes; small, medium, intermediate, large, and extra large. The size of the liner can be adjusted by means of a nylon strap and buckle that is sewn on the back of the liner.

The oxygen mask is attached to the cheek flap by means of two Pull-the-Dot snap fasteners. The matching female fasteners on the mask have a dot on their outside surface, and unlock in one direction when pulled apart away from the dot. This provides a positive locking action, insuring the pilot of keeping the oxygen mask even if he loses the protective helmet during a high-altitude bailout.

The earcups on the liner have been designed to accommodate wafer type receivers. The wafer-thin construction of the receiver decreases the lateral dimensions of the helmet, thereby decreasing the frontal area exposed to windblast during bailout and facilitating head movements within the confines of the cockpit canopy. The earcups have been designed to provide sound attenuation against ambient noise, and to increase radio reception.

One male snap fastener is located on each side of the shell exterior between the two buckles for adjusting the headband. This also provides

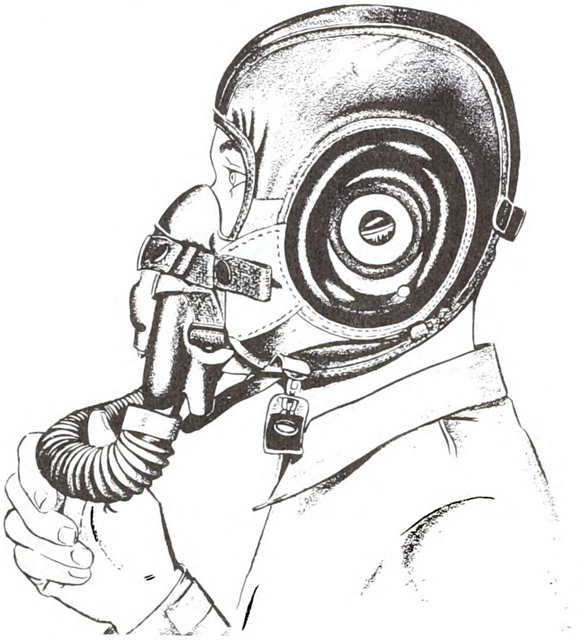


Figure 14-1.—Cloth underhelment (liner).

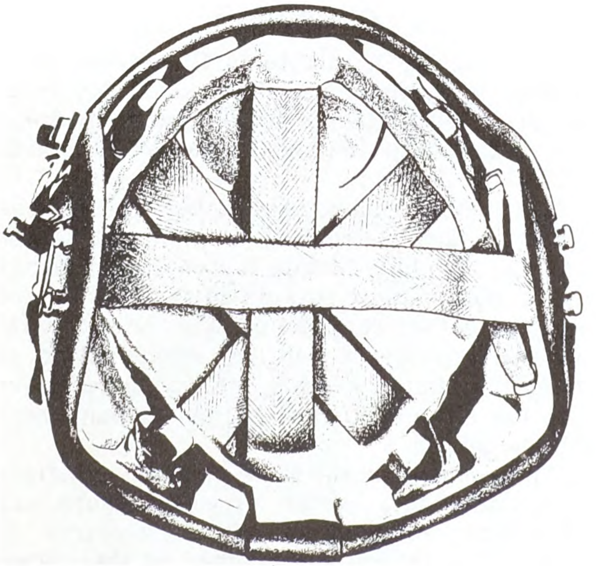


Figure 14-2.—Protective shell, inside view.

a means of attaching the goggles to the shell. In addition, a fitting is secured to the right side of the shell exterior for attaching a boom type microphone. This microphone is very fragile and should be handled with care.

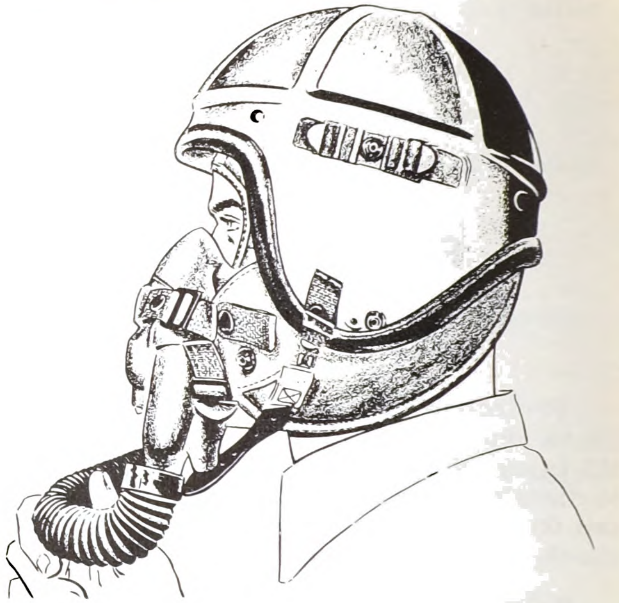


Figure 14-3.—Fully equipped H-3 protective helmet.

The rigid protective shell is composed of laminated and mat Fiberglas compounded with a polyester resin. The rigidity of the shell is increased by reinforcing-ridges located on its outer surface. A black rubber beading around the borders of the shell protects the wearer from sharp edges and provides a decorative finish.

The protective shell is available in four sizes; small, medium, large, and extra large. Tests have shown that the Navy's protective helmets will withstand an impact force in excess of 64 foot-pounds and a static load in excess of 600 pounds without structural failure.

WARNING: The wearer of the protective helmet should be instructed to not place any metal objects on the shell, especially above ear level. Under crash conditions, these additional metals may be driven into the head as secondary missiles.

Additional protection against injury from impact is provided by energy-absorbing padding within the helmet shell, consisting of four pieces of Royalite cemented directly to the shell interior and small pieces of leather-covered foam rubber placed circumferentially between the adjustable headband and the shell. Deformation of all parts of the padding under impact absorbs the impact energy, thereby decreasing the injury potential of a blow delivered to the helmet shell.

The shell is fitted to the head by means of a sling suspension having an adjustable headband. Buckles for adjustment of the headband are located on both sides of the shell exterior just above the ear level. The most protection against impact is obtained when the headband is adjusted to fit snugly. Pilots and aircrewmen should be instructed in the proper procedure to adjust the slings very carefully prior to use.

A modification on the H-3 consists of installing stabilizing straps and chinstrap to provide the additional stability needed when catapulting, on arrested landings, and in maneuvers involving high "g" accelerations. To attach the straps to the liner and outer shell on any protective helmets that have not already been made by the manufacturer, follow the procedure illustrated in figure 14-4.

The wearer need not separate the assembly after it is modified since it can be utilized as a one-piece helmet. The modified cloth underhelmet (liner) should not be worn by itself since attempts to anchor the webbing by additional male fasteners on the liner may increase the possibility of serious head injury in emergencies.

TYPE H-4 PROTECTIVE HELMET

The H-4 helmet is basically the same as the H-3 with the following exceptions:

1. The headband is fixed in front and is not adjustable.
2. The front of the helmet has been lowered for increased protection and stability.
3. The center panel of the H-4 liner is made of nylon mesh for coolness.
4. The stability of the H-4 protective helmet is an improvement over the H-3; however, the stabilizing straps omitted on the H-4 may be added when requested.

TYPE APH-5 PILOT'S PROTECTIVE HELMET

Description

The APH-5 protective helmet, shown in figure 14-5, is the Navy's newest. The helmet is available in large and medium sizes. The complete unit consists of an outer shell, energy-attenuating liner, sizing pads, integrated visor, earcup assemblies, communication cord, oxygen mask mounting tabs, nape strap, and adjustable chinstrap. Furnished with the unit is an envelope containing four shims and two screws for horizontal adjustment of the earcup assemblies. A

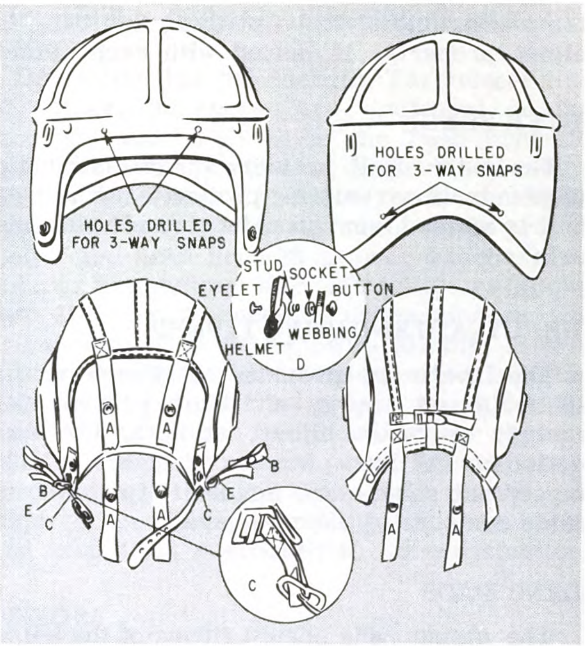


Figure 14-4. —Attachment of stabilizing straps.

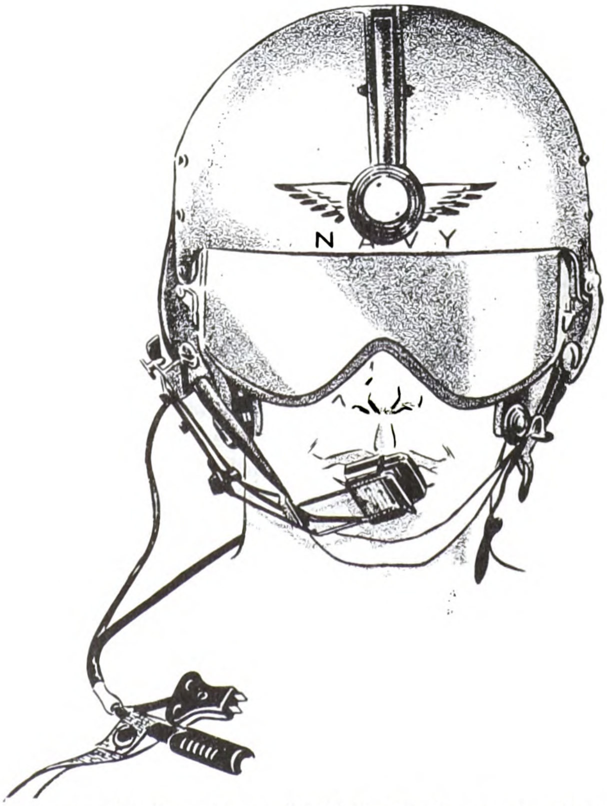


Figure 14-5. —Type APH-5 pilot's protective helmet.

sizing instrument, to be utilized in fitting the helmet properly, is issued with each helmet.

OUTER SHELL

The outer shell provides force-distribution and penetration-resisting properties. The outer shell is molded from glass fabric and a polyester resin

ENERGY-ATTENUATING LINERS

The liners are provided to absorb or dissipate impact energy and thus prevent skull fracture or brain injury, or both. The three sections of the liner, which are made of cellular polystyrene sheets, are molded to fit closely the inside contours of the outer shell.

SIZING PADS

The sizing pads permit fitting of the helmet to an individual's head contour with the proper balance between stability and comfort. The sizing pads are supplied in three basic configurations—back, crown, and front, also in two basic thicknesses—thin and thick. The pads are leather covered, miniature size to improve comfort by reducing the discomfort that could possibly result from internal heat in the helmet. *Aviation Clothing and Survival Equipment Bulletin* No. 3-57A, authorizing modification of the sizing pads, must be complied with on all helmets that are in service and not already modified.

VISOR

The integrated visor provides protection from sunglare, windblast, dust, foreign particles, and flash fires. It has excellent optical properties and crack propagation resistance and is protected from damage when in the UP position by a housing. The housing is molded from a glass fabric and a polyester resin, similar to the outer shell.

Two colors of visors are available for use in the helmet assembly: clear and neutral gray. The neutral gray visor, which is darker at the top than at the bottom to afford maximum protection from sunglare and to facilitate reading of the instrument panel, is currently supplied in various densities. This range of densities satisfies various requirements for specific visual conditions and/or individual preferences dictated by such factors as the demand by blond or light pigmented individuals for darker lenses. The relative darkness or degree of visible light transmittance is indicated by white markings on the inside edge of the visor. This marking can be seen more readily by removing the visor from the housing. Table 14-1 shows the markings and the percentage of light transmittance.

Table 14-1.--Visor marking and percentage of light transmittance.

Marking	Percentage of light transmittance
D	10 to 20 percent inclusive
XD1	8 to 10 percent (medium dark)
XXD	6 to 8 percent (dark)
XXX	5 to 6 percent (very dark)
*D	10 to 20 percent inclusive
*XD	Under 10 percent

* In the initial quantity of helmets issued to the fleet, these two types of neutral gray visors were installed.

Due to manufacturing processes, it is impractical to control transmission of the various filter visors produced. In view of this practice, medium and large size visors with varying percentages of light transmittance are carried in the supply system under a single stock number. It is recommended that personnel check lenses at squadron level to obtain individual preferences before obtaining from supply.

EARCUP ASSEMBLIES

The earcup assemblies contain the earphones and improve radio reception by providing good attenuation of outside noise. Each assembly consists of a phone housing of cellular polystyrene and an ear cushion assembly composed of a soft neoprene foam rubber body and a di-isocyonate foam face cushion. If the earcup assemblies are loose and need adjustment, the four shims and two screws contained in the envelope should be utilized to accomplish the lateral adjustment. Proper fit of the earcup is necessary for proper radio reception. The earcups have been designed with a large ear cavity to minimize the possibility of pressure discomfort to the ear. A vinyl film washer is inserted between the earcup and the shell to prevent movement of the earcup assembly in the event that the shims are not necessary for lateral adjustment.

COMMUNICATIONS ASSEMBLIES

The communication cord is designed to provide electrical connections between the earphones and the aircraft radio facilities. The molded junction block connecting the four earphone leads to the cord is located in the back left center of the helmet. It is seated in a cutout of the middle section of the cellular polystyrene energy-absorbing material.

The installation of the boom type microphone should be accomplished as follows: Pre-position the boom mike assembly on the side of the helmet. Swing the boom through a full arc to determine the optimum point. Then, scribe the intended position of the bracket, drill holes accordingly, and attach. The position will vary with the face shape and personal preference. Boom type microphones are not provided with the helmet assembly and must be ordered individually.

Type H-87A/U earphones are installed in the cellular polystyrene earcups of the ear cushion assembly. Each earphone is connected to the two wires leading out of each side of the molded junction block of the communication cord.

Fitting Technique

In order to properly fit the APH-5 helmet, the various attachments must be utilized. The oxygen mask mounting tabs provide a means of securing the oxygen mask to the face and assist in achieving a seal around the face in the oral-nasal area. The tabs are mounted in such a manner so as to permit an even distribution of pressure over the sealing area of the oxygen mask. Another function of the tabs is to assist in retaining the helmet and mask during bailout at high speeds. The chinstrap is also designed to retain the helmet during emergency escapes at speeds in excess of 500 knots.

The nape strap is designed to increase helmet retention. It is important to keep in mind that the full effectiveness of the nape strap cannot be realized unless the chinstrap is cinched up in a snug position. Retention of the helmet under emergency conditions can be insured only by the proper fitting of the helmet to the user's head and the proper utilization of the chinstrap. The nape strap merely increases the retention provided basically by the chinstrap. It must be remembered that the cinching up of the chinstrap is an additional adjustment that must be done after the oxygen mask is positioned on the face.

To properly use the sizing instrument and fit the APH-5 helmet for optimum comfort and stability, the following instructions should be applied:

Determine the head length. The helmet size and liner thickness are indicated on the horizontal bar. Determine the head breadth. When the head length dimensions provide a choice between two sizes of helmets, the head breadth should be the factor in determining the proper size. If the head breadth is over 6 inches, use the large size helmet with all thick liners (sizing pads). If the head breadth is under 6 inches, use the medium size helmet with all thin liners.

After the liners have been inserted, have the pilot don the helmet. The proper way to don the helmet is to place the thumbs over the ear cushions, and pull outward on the helmet; insert the forehead in the area between the thumbs, and complete the donning by rolling the helmet backward until it is positioned to his satisfaction.

COMFORT

If the helmet is not comfortable to the pilot, make the following suggested revisions: If a thick liner is used in the area affected, substitute a liner of lesser thickness. If the pressure point remains, choose the next larger size and use the thick liners in the unaffected area and thin liners in the affected area.

STABILITY

To obtain maximum stability, a snug fit is required. It is possible that stability has been sacrificed for comfort in relieving the pressure points. Proper stability can be determined by vigorously shaking the head. Keep in mind that the pilot must be the judge in determining the correct balance between comfort and stability of the helmet.

After the fitting has been accomplished and sufficient flights have been made to determine adequacy of fit, the unused sizing pads, shims, and sizing instruments should be returned to the local supply for reissue. In addition, clear visors that are not being used should be returned to supply for reissue.

Maintenance

There will be a minimum amount of maintenance on the helmet since the pilot keeps it in his possession. On occasions, there will be some maintenance such as recementing loose sizing pads, liners, etc. When not in use, the helmet should always be kept in the bag provided.

Changing the Visor

Changing the visor on the APH-5 helmet is a simple task, but the following procedure should be followed: Locate the visor in the UP position. Disengage the keepers by lifting up on their thumb tabs and pivoting them downward 90 degrees. Press down on the center portion of the button and lift up on the peripheral plastic section. When the button spring is fully compressed, turn the entire button 90 degrees and remove the visor from the bottom of the housing.

To insert a visor replacement, this procedure is reversed.

CLEANING THE VISORS

The following procedure for cleaning visors is recommended:

Wash the visor with mild soap and water, using clean rags. If the visor is still soiled or if it is necessary to remove minor scratches, use polish. Specification MIL-C-18767 polish is used on acrylic plastic. To preserve the surface, use polishing wax for the final application. The wax to be used on the visors can be ordered by stock number FSN R7930-266-7125-G600.

REPLACEMENT OF ELECTRONIC EQUIPMENT

To replace the communication cord, remove the ear cushion assembly from the helmet by removing the screw on each side of the outer shell. The earphones can be disconnected from the wiring harness after the ear cushion proper has been removed from the polystyrene housing. At this point, release the screw engaging the clip and junction plate at the rear portion of the helmet for complete removal of the communication cord.

To replace the communication equipment, reverse the above procedure.

Installation of the Hardman Oxygen Mask Retention Kit

The Hardman 3740 oxygen mask retention kits are provided for attaching the A-13A oxygen mask to the APH-5 pilot's protective helmet. The installation of this kit will afford greater retention of the mask and helmet during high-altitude/high-speed bailouts.

OXYGEN MASK AND HELMET MODIFICATION

Before attempting to install the retention kit, make certain that the oxygen mask and the kit are of the same size. Remove all the straps and the metal yoke from the mask. Cut off the protruding rubber strap attachment loops from the mask. This is done by cutting flush at the mask surface with a sharp knife or a pair of end cutters. Remove the lip strap supporting the sealing flanges of the mask. The removal of the lip strap is optional for comfort. The stripped oxygen mask is now placed in the retainer shield assembly.

Remove the earphone assembly, the oxygen mask leather tabs, and chinstrap from the helmet.

ADJUSTMENT TO PERSONNEL

As shown in figure 14-6, locate a point 1-1/8 to 1-1/4 inch below the end of the visor track and 1 to 1-1/8 inch back of forward edge of helmet. Drill a 3/16-inch diameter hole at this location.

Place the backing plate on the inside of the helmet and the latch assembly on the outside of the helmet. Insert the long screw with lockwasher into alined hole from the backing plate. This screw is tightened until friction against the helmet will hold the latch assembly in place. This step is repeated for the opposite side. Reinstall the earphone assembly.

Don the helmet and insert the bayonets to the third notch. Adjust the straps to provide uniform tension and proper positioning of the oxygen mask to the face.

Adjust the latch assembly by rotating on the screw, either up or down as required, lining up the bayonet center line with the latch assembly

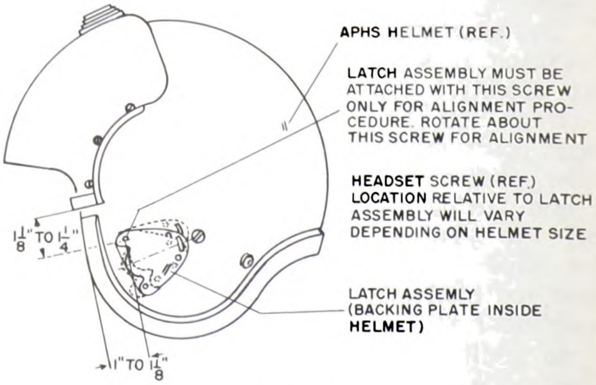

APHS HELMET (REF.)
LATCH ASSEMBLY MUST BE ATTACHED WITH THIS SCREW ONLY FOR ALIGNMENT PROCEDURE. ROTATE ABOUT THIS SCREW FOR ALIGNMENT
HEADSET SCREW (REF.) LOCATION RELATIVE TO LATCH ASSEMBLY WILL VARY DEPENDING ON HELMET SIZE
LATCH ASSEMLY (BACKING PLATE INSIDE HELMET)
1 1/8" TO 1 1/4"
1" TO 1 1/8"

Figure 14-6.--Alignment of the latch assembly.

center line, as shown in figures 14-6 and 14-7. This provides proper distribution of tension required to support the oxygen mask and facilitates proper release characteristics. If tension is evenly distributed between the two straps on either side, the bayonets should release with no binding tendency.

After proper positioning of the latch assembly, remove the oxygen mask and mark or scribe the location of the three additional mounting screw holes. Remove the earphone assemblies, backing plate, and latch assembly, and drill the additional holes 3/16 inch in diameter. Secure the backing plate assembly, and reinstall the earphone assemblies.

Remove the oxygen mask. Insert the bayonets to the third notch. Tighten the four adjustable straps to provide a snug fit of the oxygen mask, maintaining equal tension on all straps. When the mask has been adjusted for normal wearing, with the bayonets in the third notch position on each side, two additional steps of increased tension are actually available, since each bayonet can be tightened independently another notch.

TYPE S/PH-1 PROTECTIVE HELMET

The S/PH-1 helmet is the Navy standard noise-attenuating protective helmet. This helmet is used by flight crews of helicopter and VS squadrons. It is constructed differently from the previously described helmets and is described in detail in the following paragraphs.

Description

The type S/PH-1 helicopter helmet consists of two major assemblies, each of which is drawn from supply as a separate item. The outer shell assembly, shown in figure 14-8, is available in 3 sizes — small, medium, and large. The outer shell assembly is furnished complete with edgeroll, cloth cover which is used with the inner foam liner, microphone plug holder, and chinstrap assembly. The chinstrap consists of the strap, chin cup and microphone adapter. Each outer shell assembly is also furnished with a separate strip of sizing material.

The outer major assembly consists of the inner foam liner which is available in 7 sizes.

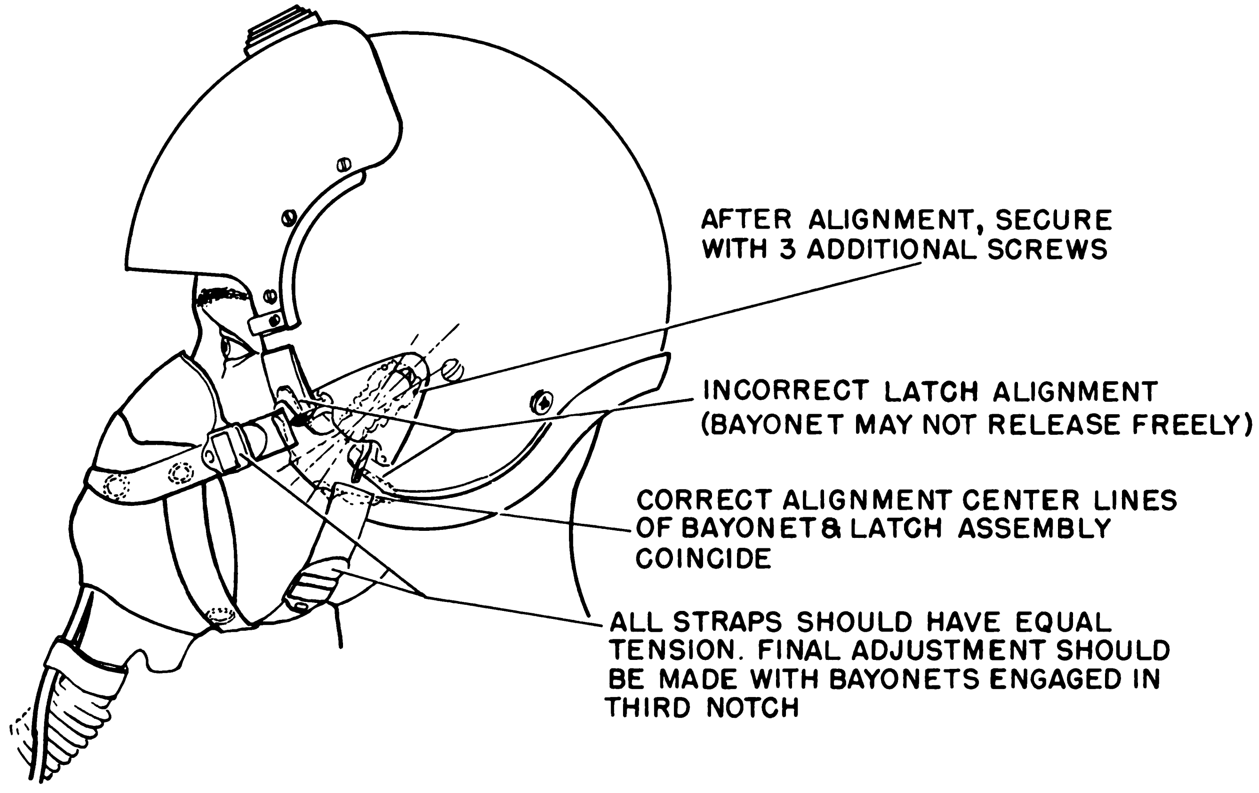

AFTER ALIGNMENT, SECURE WITH 3 ADDITIONAL SCREWS
INCORRECT LATCH ALIGNMENT (BAYONET MAY NOT RELEASE FREELY)
CORRECT ALIGNMENT CENTER LINES OF BAYONET & LATCH ASSEMBLY COINCIDE
ALL STRAPS SHOULD HAVE EQUAL TENSION. FINAL ADJUSTMENT SHOULD BE MADE WITH BAYONETS ENGAGED IN THIRD NOTCH

Figure 14-7.—Alignment of oxygen mask straps and bayonets.

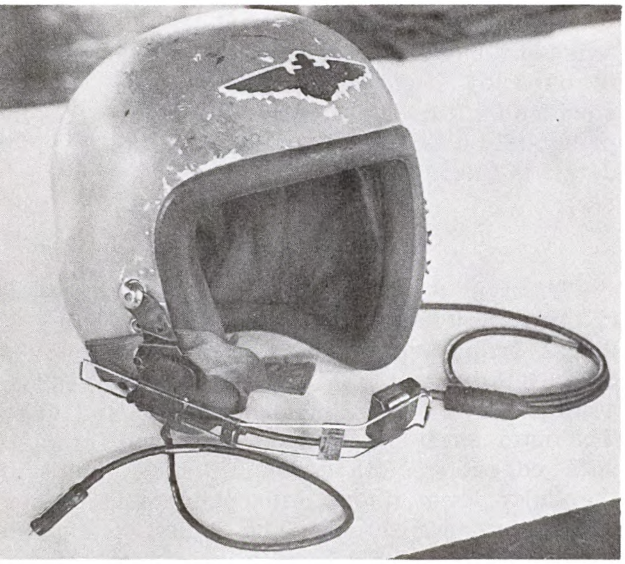
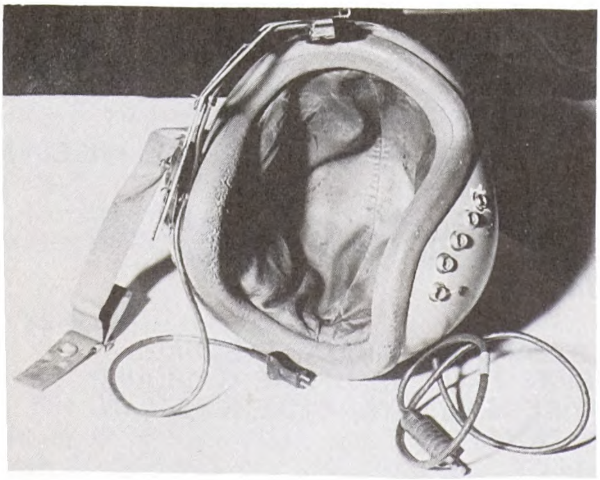


Figure 14-8.—S/PH-1 outer shell assembly.

Figure 14-9 shows the foam liner and cloth iner installed in the outer shell assembly.

OUTER SHELL

The outer shell affords impact and penetraion protection. It is molded from an epoxy mpregnated fiber glass which is pliable. An epoxy resin type paint applied to the outer surface of the shell affords a smooth, tough surface which will not chip or crack under ormal usage.



igure 14-9.—S/PH-1 inner foam liner installed in the outer shell assembly.

EDGEROLL

The edgeroll is a molded neoprene foam edging that is installed around the face opening of the outer shell. It affords a seal that aids in sound attenuation.

CLOTH LINER

The cloth liner is available in three sizes—small, medium, and large. Each liner contains two fasteners located in the front and the back. These snaps provide an attachment to the inner foam liner. The cloth liner is fabricated from a double stitched preshrunk rayon-gabardine material. This cloth liner is easily removed from the inner foam liner for washing.

CHINSTRAP ASSEMBLY

The chinstrap assembly is attached to the outer shell and Pull-the-DOT fasteners. The strap is fabricated from nylon material and incorporates a chin cup to improve the helmet retention and comfort. There is also a microphone adapter attached to the chin cup for installation of the wafer type microphone.

INNER FOAM LINER

The inner foam liner is molded from di-isocynate foam material and was designed so as to attenuate external high-frequency sounds. The liner is molded to form fit the shell interior. Impact energy is distributed over a large area of this liner due to the top portion being of a special energy-absorbing di-isocynate material. The inner foam liner is attached to the outer shell by snap fasteners and is easily removed for washing. The earphones receivers are installed within cavities built into the inner foam liner, eliminating the possibility of pressure discomfort to the ears. A strip of sizing material (24 x 2) is furnished for strip cutting to facilitate greater comfort to the rear cavity section of the shell.

COMMUNICATIONS EQUIPMENT

The communications equipment is not furnished with the helmet. It should be ordered separately at the time the helmet and liner are ordered. A type M-3A/A microphone is used and is installed on the adapter provided on the chin cup. A type H-87A/U headset assembly should be installed in the cavities provided in the inner foam liner. The communication cord is routed through the grommet provided on the rear left side of the helmet. The microphone plug-holder slips under the grommet provided for the headset receiver cord outlet, in the lower left rear position of the outer shell. This holder is provided to prevent the microphone plug from hanging loosely when not in use.

Fitting Technique

A combination of the various sizes of outer shell and inner foam liners available will serve to provide a good fit for those individuals requiring hat sizes from 6 3/4 to 7 5/8 or head circumferences from 21 1/4 inches to 24 inches. Normal head height variations are compensated for within the soft foam inner liner.

The wearer should first don the helmet with the size that corresponds to his hat size. The proper method for donning the helmet is to have the individual place the thumbs on the inside ear portion and pull outward on the helmet, inserting the forehead in the area between the two thumbs. Donning of the helmet is completed by rolling the helmet backward until it is positioned to the individual's satisfaction.

A good fitting consists of a tight seal at the cheek, forehead, and nape of the neck. Recommended sizes will not prove completely adequate in all cases, and further attempts should be made to attain proper fit by interchanging liners and outer shells. Fitting for undue pressure which results in discomfort after a short period of wear must be corrected.

FOREHEAD AREA

For correcting the fit of the forehead area, substitute the next larger size liner or smaller size liner depending upon whether the forehead slopes in or out.

CHEEKBONE AREA

To correct the fit of the cheekbone area, substitute the next larger size shell, either utilizing the same inner foam liner or the smallest liner called for within the next shell size range of liners.

Substitute the next smaller size liner to help correct the fit of the crown of the head or nape of the neck.

EAR CAVITIES

Since the helmet liner ear cavity is basically designed to eliminate pressure on the ears for standard head sizes, a person with small head width, measured from ear to ear, may not be able to enjoy optimum in hearing quality. To correct this, cut a small square of the sizing material that is furnished with the assembly. Cement this material to the shell at the ear cavity. This will move the imbedded earphones closer to the ears.

Procedure For Removal and Replacement of Inner Foam Liner

To remove the inner foam liner, lay the helmet on the lap or table. Unsnap the two fasteners connecting the inner foam liner to the shell. Facing the bottom of the helmet, insert the hand between the farthest side of the inner liner and the shell to any point on the head crown surface of the liner. Then press that side in toward the center of the helmet and pull the hand and liner out with a rolling motion toward the opposite and rear of the shell.

To replace the inner foam liner, grasp both extremities of the liner ear cavities and press them together. Insert the liner sideways from the rear of the shell with the front of the liner pointing straight down. After the liner passes the ear cavity of the shell, release your handhold and regrasp the liner at its back center with fingers between the liner and shell. Then push the liner down and forward to the front center of the shell. Resnap the two fasteners, and tuck in the cloth cover as needed.

Oxygen Masks

Oxygen masks are pilot's personal equipment, and after the initial fitting, they are retained by the individual to whom issued. Fitting, adjustments, maintenance, cleaning, and incorporating modifications are the responsibility of the Parachute Riggers of the supporting activity. Oxygen masks are the final link in conveying oxygen from the aircraft system to the user. A satisfactory regulator and oxygen system, or a full cylinder of oxygen is of little value to a pilot if his oxygen mask is not operating properly in every respect.

Two types of oxygen masks are discussed in this section. They are the PRESSURE BREATHING MASK and the DEMAND OXYGEN MASK.

PRESSURE BREATHING MASK

The pressure breathing mask used in the Navy is designated as the A-13A. This oxygen mask is used with composite diluter demand systems, with straight diluter demand systems (with no emergency valve), with automatic positive pressure diluter demand regulators, or with the miniature positive pressure 100 percent demand mask-mounted regulator. The A-13A oxygen masks currently used are satisfactory for flights up to 43,000 feet altitude without regard to service life if properly serviced. The incorporation of the laminar seal improves fitting and comfort of the mask to the face.

Construction

The A-13A pressure breathing oxygen mask, shown in figure 14-10, consists of a facepiece, inhalation valves, pressure compensating exhalation valve, microphone cavity, harness assembly, and breathing tube assembly. The mask is equipped with a yoke assembly and Pull-the-Dot fasteners which allow for easy attachment and quick release in the event of ditching at sea. It has two cheek flaps that cover about half the face. The A-13A mask is supplied in sizes small, medium, and large. The mask should be selected to fit the facial features of the user.

With the exception of the yoke assembly, suspension straps, and laminated face seal, the A-13A mask is molded from a high crude rubber content stock of a medium green color. This stock is compounded to resist mildew and remain flexible at a low temperature. Figure 14-11 shows an inside view of the mask.

Operation

When a flow of oxygen under pressure is supplied to the mask, the pilot must exhale at a pressure greater than that of the oxygen intake in order to open the pressure compensated exhalation valve and complete the breathing cycle. Figure 14-12 illustrates the operation of the A-13A mask with the diluter demand system, and figure 14-13 illustrates the operation of the mask with the pressure breathing system.

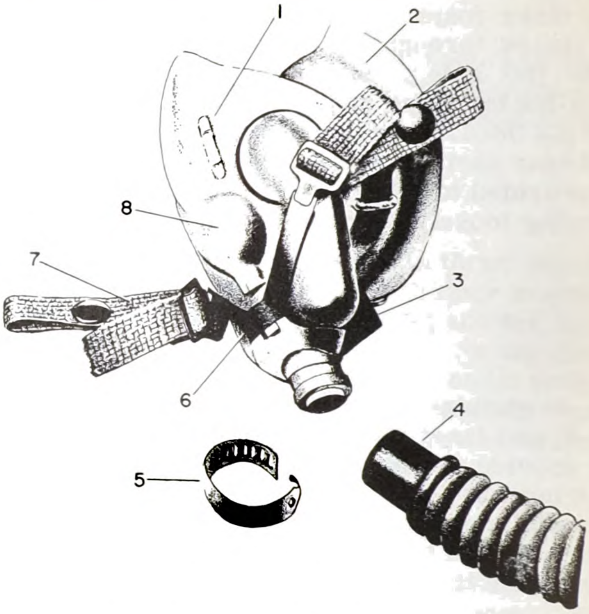


Figure 14-10.—Type A-13A pressure breathing oxygen mask.

1. Facepiece.
2. Cheek flap.
3. Exhalation valve port.
4. Breathing tube.
5. Hose clamp.
6. Yoke assembly.
7. Harness with fastener.
8. Microphone cavity.

The inhalation valve assembly is composed of a plastic valve seat, a rubber flapper, a valve gasket, and a plastic cover. The oxygen passes through an integral inlet tube located inside the mask at a point where it fits on the chin. The oxygen is then fed to the interior of the mask by two inlet ducts, one on each side of the mask. The inhalation check valves (round rubber covers) prevent the exhaled air from passing back through the inhalation ducts of the facepiece. A plastic cover eliminates the collection of moisture around the valve where it may freeze under extremely cold conditions.

The pressure compensating exhalation valve, shown in figure 14-14, is made to fit into a tube (14) which extends through a hole in the wall that separates the exhalation port housing and the inhalation valve ducts. This arrangement permits the open end of the tube to be exposed to the oxygen as it passes from the inhalation

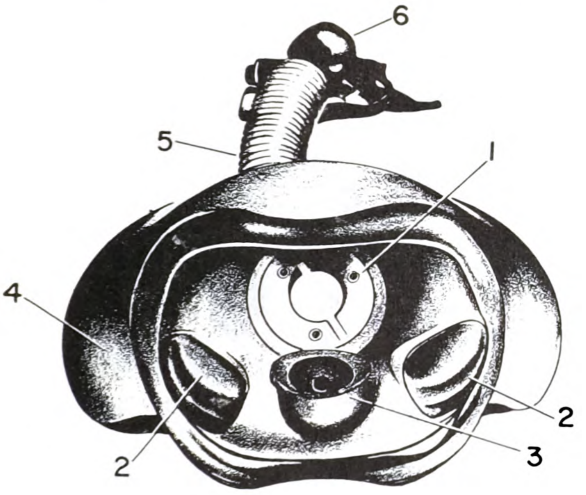


Figure 14-11.—Inside view of the A-13A mask.

1. Pressure compensated exhalation valve.
2. Inhalation valve port.
3. Microphone cavity.
4. Cheek flap.
5. Breathing tube.
6. Connector assembly.

valve duct into the facepiece. The tube of the exhalation valve brings oxygen pressure to bear against the lower side of the compensating diaphragm (15). This pressure, plus the pressure of a calibrated spring, causes the diaphragm to close the valve. In this position, no oxygen can escape from the facepiece.

As the pressure in the facepiece is increased against the main diaphragm (10), because of exhalation of the wearer, the combined pressure in the inhalation duct and the calibrated spring is overcome, and the valve opens. Exhaled air (9) escapes from the exhalation port at the bottom of the facepiece. The valve is so constructed that a pressure of only 1 millimeter of mercury greater than that of which is being supplied by the regulator will force it open.

Microphone Installation

The ANB-M-C1 microphone used with the oxygen mask is drawn from supply by the pilot at the time he draws his oxygen mask and other personal flight gear. The original installation of the microphone is the responsibility of the Parachute Rigger. The repair of any reported malfunctions and modifications is the responsibility of the avionics division and is to be performed by electronics technicians.

Following is the procedure for the installation of the ANB-M-C1 microphone:

Disassemble mask and clean facepiece and corrugated hose in a solution of mild soap, Specification MIL-C-18687 (Aer), and warm water.

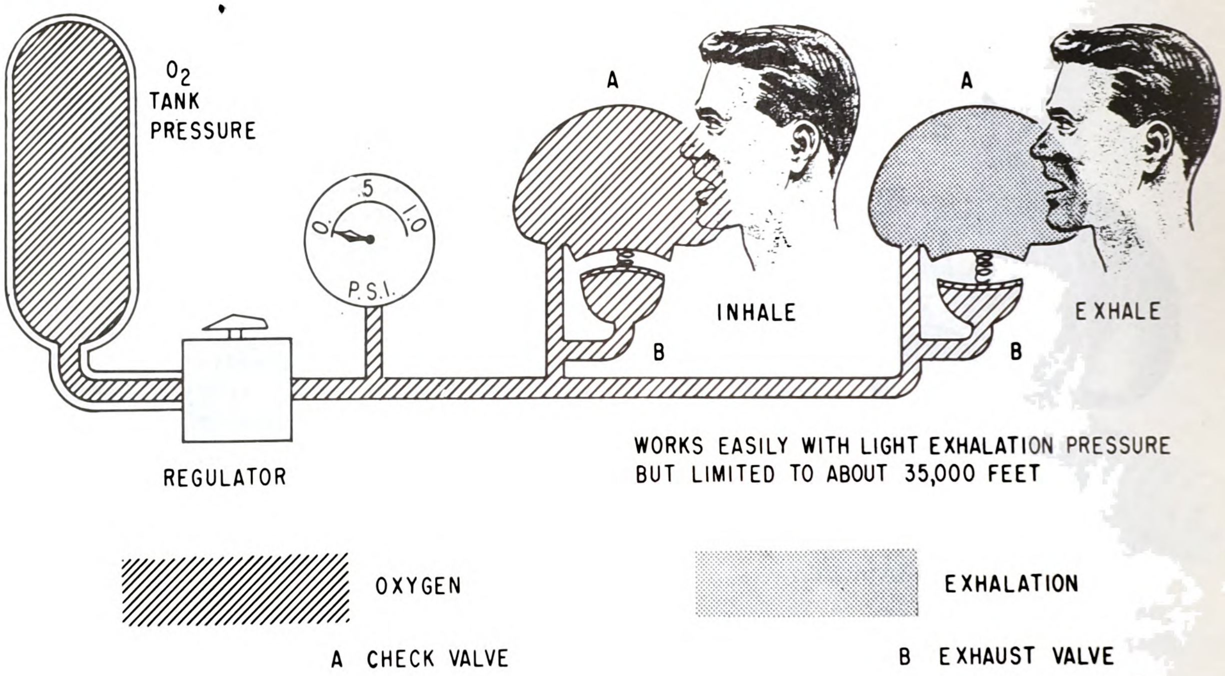
Remove all traces of any white granular substance which may be present in new masks. If not removed, an excessive amount of these tiny granules can become trapped under the rubber flaps of the inhalation valves thereby preventing a perfect seat. The inhalation valves and their rubber valve flaps must be perfectly seated to prevent an equalizing back pressure into the mask tube. Such a condition will prevent use of the exhalation valve.

Before installing the exhalation valve, clean it in a solution of methyl alcohol, removing dirt and dust particles that lie between the diaphragms and their contacting seats. Particles of dirt trapped under the diaphragm can prevent the exhalation valve from closing off, thereby permitting outside air to be drawn in, diluting the oxygen. Dry and reassemble mask with the exception of the inhalation valves. Leaving the inhalation valves out of the facepiece until after the microphone is installed, makes it easier to install.

To prevent moisture from later forming in the microphone cavity and damaging the installed microphone, it must be vented. This vent, no greater in diameter than 0.030 of an inch, is burned through the center of the microphone cavity with a hot wire. After this operation has been performed, the mask cannot be used unless a microphone is installed in the cavity, thus sealing off leakage from the vent. In the event a microphone cannot be reinstalled in the empty vented-mask cavity, the vent can be plugged. However, it is indeed unlikely, excepting emergencies, that a mask will ever be used without being provided with a means of communication.

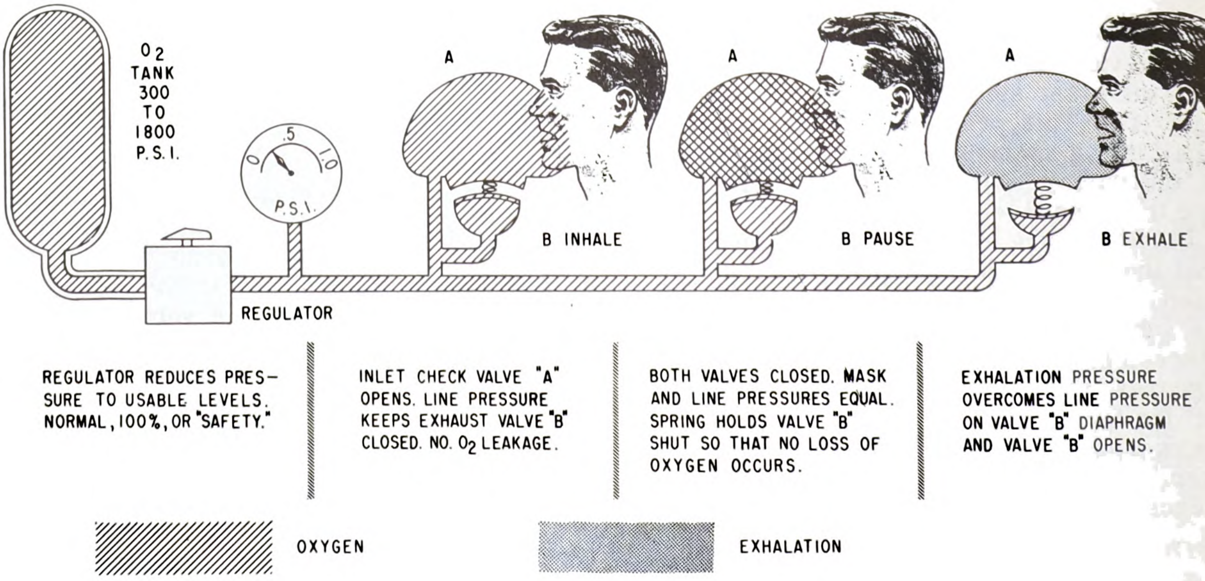
The steps required for the installation of the ANB-M-C1 microphone are illustrated in figure 14-15.

1. Remove the microphone cord "hole plug" by pulling it out at the front of the mask (step A).
2. Pass the microphone cable through the rubber guide at the front of the mask (step B).
3. Insert tapered long nose pliers through mike cord hole from the inside of the mask; tips



WORKS EASILY WITH LIGHT EXHALATION PRESSURE BUT LIMITED TO ABOUT 35,000 FEET

Figure 14-12.—Operation of the A-13A oxygen mask with the diluter demand system.



REGULATOR REDUCES PRESSURE TO USABLE LEVELS. NORMAL, 100%, OR "SAFETY."

INLET CHECK VALVE "A" OPENS. LINE PRESSURE KEEPS EXHAUST VALVE "B" CLOSED. NO. O_2 LEAKAGE.

BOTH VALVES CLOSED. MASK AND LINE PRESSURES EQUAL. SPRING HOLDS VALVE "B" SHUT SO THAT NO LOSS OF OXYGEN OCCURS.

EXHALATION PRESSURE OVERCOMES LINE PRESSURE ON VALVE "B" DIAPHRAGM AND VALVE "B" OPENS.

Figure 14-13.—Operation of the A-13A oxygen mask with the pressure breathing system.

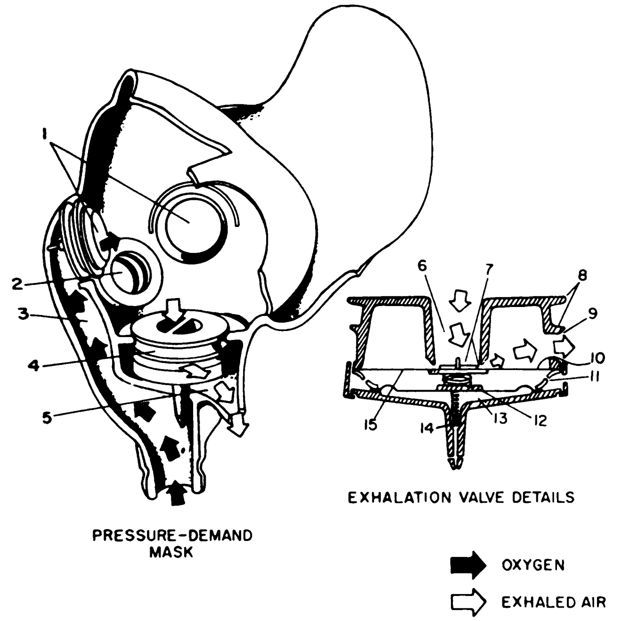


Figure 14-14.—Cutway of pressure demand mask, and exhalation valve details.

1. Inhalation valves.
2. Microphone cavity.
3. Inlet port to mask.
4. Pressure compensated exhalation valve.
5. Outlet for exhaled air.
6. Exhaled air enters exhalation valve here.
7. These plates stiffen the main diaphragm.
8. Projections on valve housing which seat in mask.
9. Exhaled air leaves the valve here.
10. Main diapgragm.
11. This port permits pressure between the two diaphragms to equalize with the outside atmosphere.
12. This cup holds hairspring in place between the two diaphragms.
13. Oxygen supply pressure is exerted in this compensating chamber.
14. This tube sticks down into the mask inlet.
15. This compensating diaphragm responds to oxygen supply pressure by pressing up against the diaphragm.

of the pliers must show at least 1/8 inch beyond the outside edge of the hole (step C).

4. With the pliers opened slightly, just enough to permit a sure grip on the outer diameter of the cord, insert the end of the microphone cable through the elongated hole. Handle the pliers carefully in order to avoid tearing the hole and the rubber bridge piece joining the inner mask lips (step D).

5. Pull enough cable up into the mask so as to gain an adequate length for connecting the terminals to the microphone. Once the outer diameter of the microphone cable has been grasped by the pliers, do not loosen the grip until the cable has been drawn through the hole. Loosening the grip while drawing the cable through the hole usually results in a second unseen grip on the frail terminal wires with subsequent damage to the cables and/or terminal ends (step E).

6. Remove the microphone from its plastic adapter by unscrewing. This plastic case and case cover are of no further use as they are not inserted into the microphone cavity of the oxygen mask. Remove the three connections from the back side of the microphone (step F).

7. Attach the wire terminals to the microphone with the lockwashers beneath the terminals (step G).

8. After the terminals have been connected draw the mike down to its cavity in the forward position of the oxygen mask. Do not pull the cord abruptly, and stop the pulling action when the mike is flush with the rim of the cavity (step H).

9. Using your thumbs on the inside of the mask and in contact with the microphone, work the mike into its cavity slowly and progressively. When a part of the mike has been entered into its seat, pull out more of the surplus cable. When doing this, be careful not to break the terminal connections. Completely seat the mike in its cavity (step I).

10. Being exceptionally careful, pull out all the remaining surplus cable and remove the slack between the guide and where it emerges from the hole (step J).

11. Replace the inhalation valves and covers, making certain that the arrows on the covers are pointing down. If the inside surface of the plastic covers have not been scored, preventing the rubber valves from sticking to them, comply with the latest NavAer publication referencing the modification. All newly manufactured inhalation valve covers will already be modified, making the field change unnecessary.

12. Place the oxygen mask to your face and check for leakage around the hole where the microphone cable enters the mask. Test the breathing action of the mask on a mockup system, using safety pressure.

13. Have the installed microphone BENCH CHECKED by the avionics division, making certain that it will work properly.

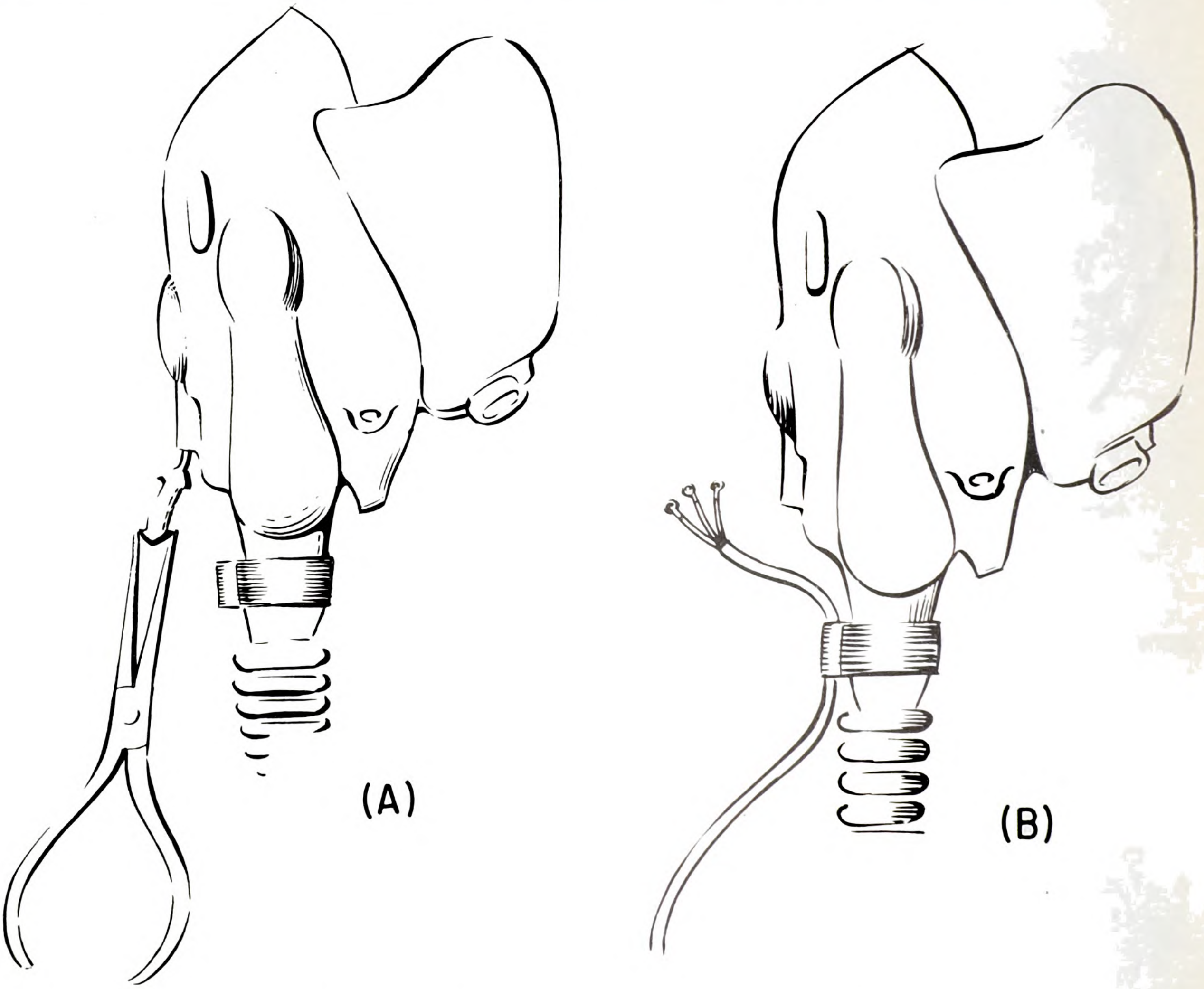


Figure 14-15.—Installation steps for the ANB-M-C1 microphone.

Testing and Inspecting A-13A Mask

PREFLIGHT TESTS

Preflight tests should be made to establish the security of all parts, with special attention given to the inlet check valves and exhalation valve. The plastic shields must be scored on the inside and be snap seated over the inlet valves.

The arrows on the shields should point downward to prevent excessive moisture in the valves. The inlet valves and exhalation valve must be free from dirt and dust particles. A preflight test should be made just prior to each flight by attaching the mask to the pressure demand regulator installed in the aircraft. The operational check should be under both demand and pressure demand conditions. In the event any difficulty is encountered, the flight should be canceled or the oxygen mask replaced.

Check the mask for fit and minimum mask leakage in the following manner:

1. Adjust the mask securely in place and connect the mask to the regulator breathing tube.
2. With the oxygen system turned on, place the regulator safety pressure selector lever in the ON position. Induce a severe outboard mask leakage by placing two fingers under the mask sealing surface (cheek flaps) and observe the flow indicator which should remain in the FLOW position.
3. Reposition the mask on the face and after a few respirations, hold the breath and again

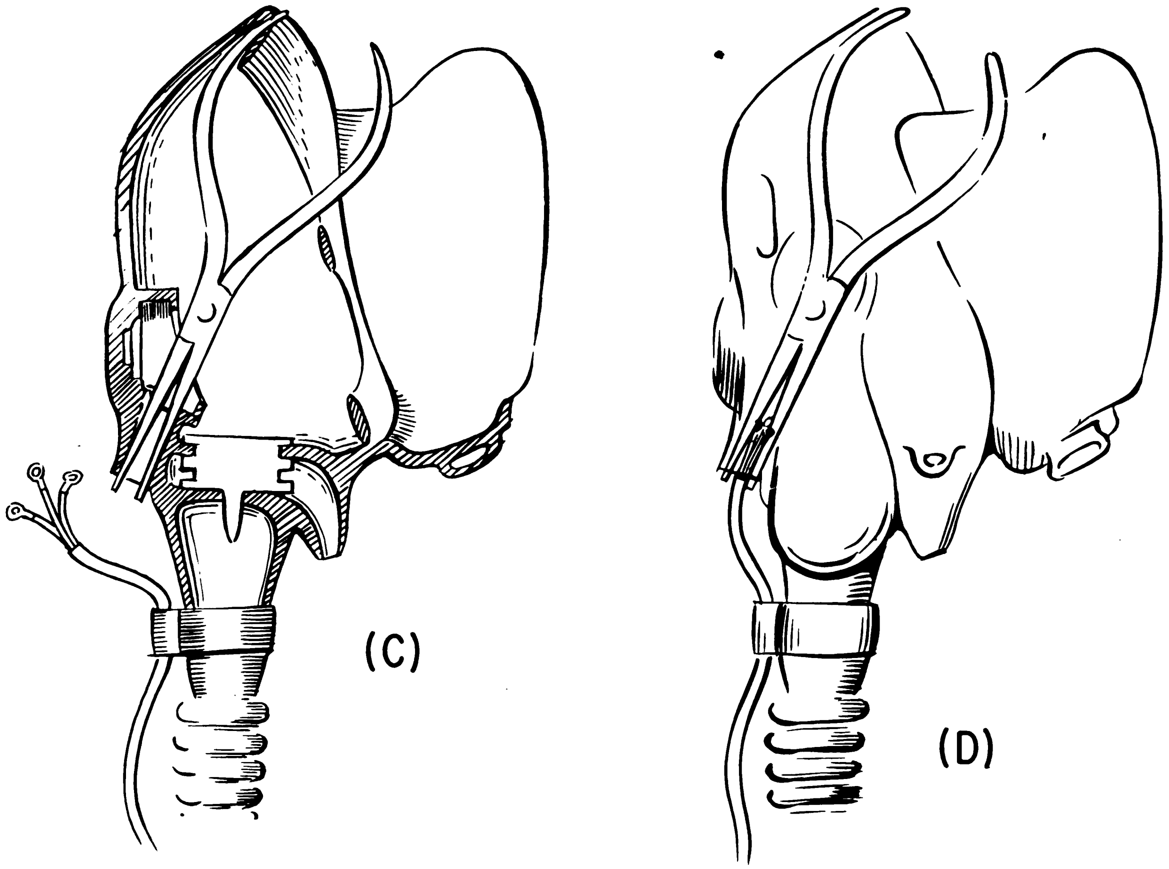


Figure 14-15.—Installation steps for the ANB-M-C1 microphone. (Continued)

observe flow indicator. If there is not mask leakage, the flow indicator will remain in the NO FLOW position. If there is any leakage the flow indicator will assume the FLOW indication position.

4. Adjust the suspension straps until the leakage is stopped.

5. Return the safety pressure selector lever to the OFF position and continue with flight preparations.

MASK HOSE AND FITTING LEAKAGE TESTING

Affixing the mask assembly to the face with the helmet in place and, using the mask suspension, adjust the strap for a snug comfortable leak-tight fit. Block the inlet port of the distal end connector assembly, inhale sharply and deeply, and hold the inhalation (keep inhaling) as long as possible. If there is no inboard leakage, immediate signs of suffocation will be evident.

VALVE ASSEMBLIES

With both inhalation valves and the compensated exhalation valve installed in the mask assembly, place a clean smooth rubber stopper (size No. 1), or equivalent, firmly in the aircraft oxygen inlet end of the distal end connector assembly and perform the following tests:

1. Inhalation Valve: Holding the mask close to the face, but not sealed to the face, and while supporting the distal end connector steadily in the hand, inhale deeply. Then press the mask to the face and exhale forcibly and completely through the exhalation valve. If the inhalation valves are not closing (sealing) properly, the exhalation valve will not open. If the inhalation valves are seating properly the exhalation will be smooth and with minimum resistance.

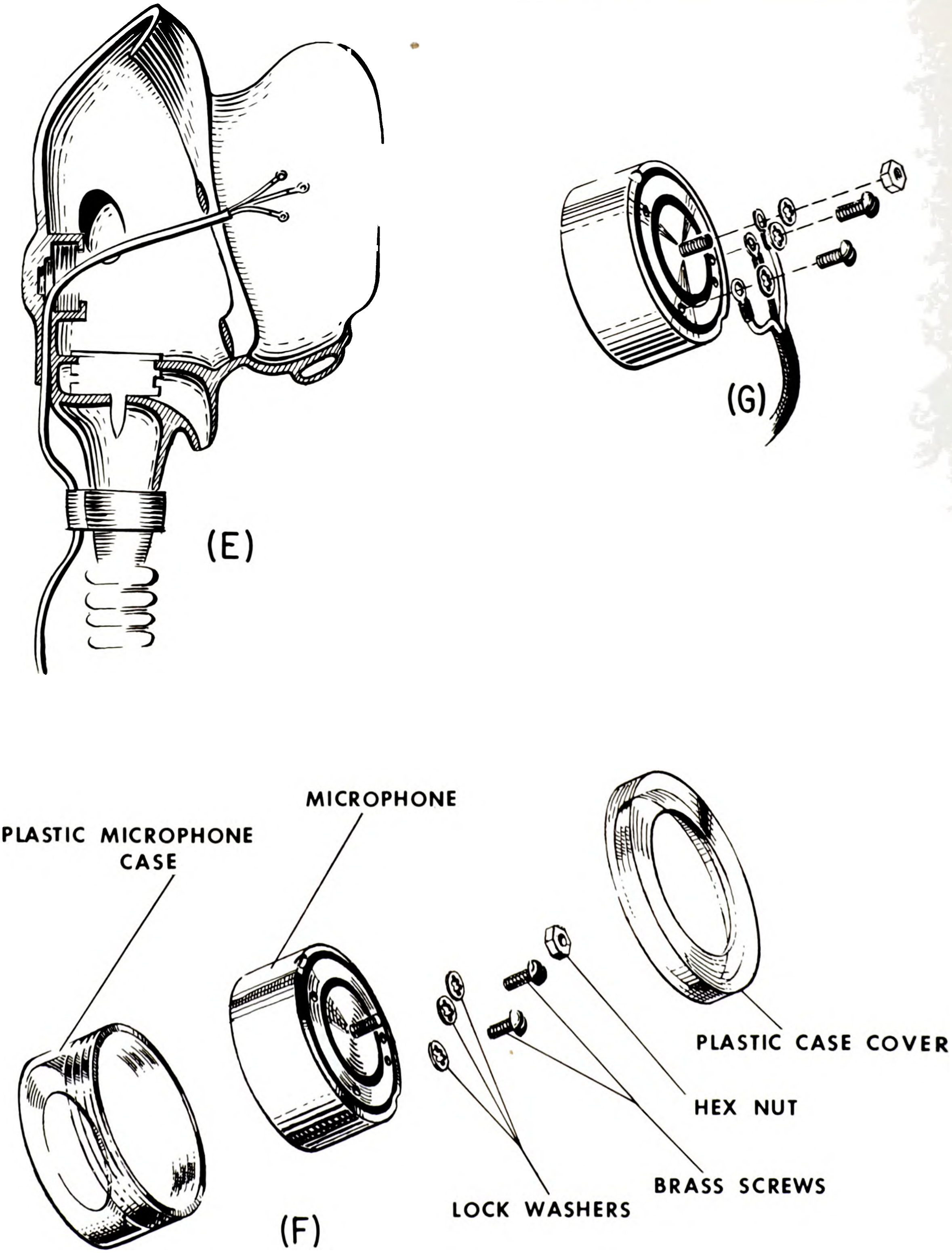


Figure 14-15. —Installation steps for the ANB-M-C1 microphone. (Continued)

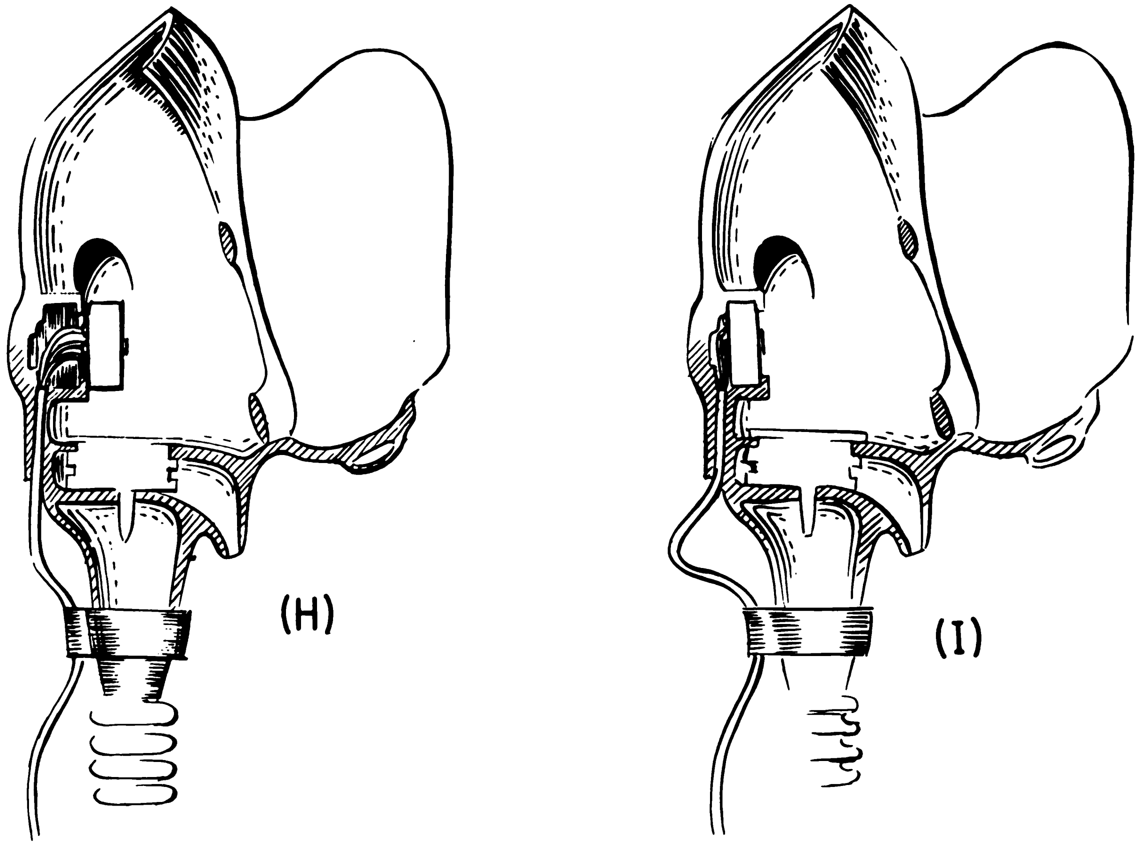


Figure 14-15.—Installation steps for the ANB-M-C1 microphone. (Continued)

2. Exhalation Valve: Place an obstruction (rubber band or equal) under the rubber flapper of one of the inhalation valves in such a manner as to prevent it from forming a seal. Repeat the testing procedure as described in test No. 1. If the exhalation valve is functioning properly, it will not open when the subject exhales, and exhalation through the valve will not be possible.

Installation of Laminate Seal

This modification must be accomplished by station or squadron Parachute Riggers or qualified personnel of Overhaul and Repair Departments. Activities not having qualified personnel to perform this required modification should contact the nearest available qualified activity.

This modification on the A-13A oxygen mask is accomplished as follows:

1. Thoroughly roughen the sealing surface of the facepiece with emery paper or any other suitable abrasive.

2. Apply an even, medium coat of cement to the rough side of the laminate and to the surface of the mask previously roughened. NOTE: The container of cement should be tightly sealed when not in actual use.

3. Determine the approximate center line of facepiece sealing surface and center line of laminate.

4. When applied cement feels tacky, lightly lay the upper nose of the laminate and the mask sealing surface in such a manner that the points of the respective center lines coincide. Care should be exercised so that the rest of the tacky surfaces do not contact each other until symmetrical alignment is obtained.

5. After alignment is assured, lay the laminate and press tightly against facepiece and allow to dry thoroughly (approximate drying time 1 hour).

NOTE: If laminate is not positioned correctly, of if a wrinkle has developed in laminate, strip laminate from facepiece. Clean facepiece with solvent and repeat, using a new laminate.

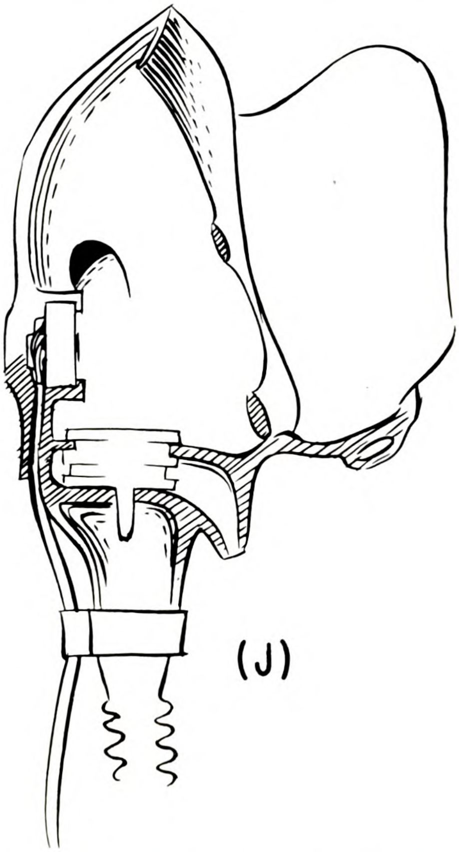


Figure 14-15.—Installation steps for the ANB-M-C1 microphone. (Continued)

DEMAND OXYGEN MASKS

The A-14 oxygen mask should be used with a demand system not having safety pressure features. It is designed to supply adequate oxygen during bodily exercise in extreme cold at an altitude up to 37,500 feet. With added precaution adequate oxygen is supplied to 40,000 feet.

The A-14 mask assembly consists of a mask body which completely covers the nose and mouth. It is fitted with an exhalation valve of the rubber flutter type. The adjustable straps of the suspension harness are arranged differently in comparison with the pressure type mask. The corrugated mask tube is equipped at the opposite end with a single male connector fitting. Regular snap fasteners (not the 3-way snap type) are provided for attachment of the mask harness of the helmet. The microphone is installed in a cavity similarly located to that in the pressure mask. Since it was not designed to hold pressure, there are no inhalation valves installed in the open ports of the A-14 mask. Its exhalation valve, as mentioned before, is very simple in construction and is designed to prevent air from entering the mask upon inhalation. This means that the rubber flapper is located on the OUTSIDE of the valve. A rubber cover, or protector, for the inhalation ports is secured to the inside of the facepiece. It is designed to prevent moisture from entering the ports and/or to prevent the formation of ice in the same vicinity. When so constructed the mask is called A-14A.

There are no inner lips in the A-14. The exhalation valve, seated in the bottom of the mask, permits exhaled air to flow out of the mask through two ports, one on each side of the mask exterior. You will notice that one of these ports is larger than the other. The larger one allows inspection of the outer portion of the flutter valve and seating of the valve proper.

The exterior microphone cable duct on the A-14 mask is different from the pressure type's cable duct. In order to gain entrance of the cable to the cavity, the tip of the projecting smooth molded cable duct must be cut off. In doing this, care must be taken not to cut off too much of the tip. Removing an excessive amount of duct will result in a hole too large in diameter to adequately seal itself around the cable.

The A-14 mask is available in four sizes; large, medium, small, and extra small.

Maintenance

As in the case with pressure type masks having microphones installed, or any other item of equipment fitted with electrical gear, do not clean by submerging in water. For thorough cleaning, always remove the microphone and disassemble the mask and tube connections completely.

When necessary, the A-14 mask can easily be equipped with the bailout connector used on pressure type masks. The same general line of maintenance procedure applies to this type mask as it does with the A-13A. Being simpler in construction and lacking the valves and internal sealing arrangement incorporated in pressure types, the A-14 mask is easier to maintain on a serviceable condition. However, the same major rules apply to both masks. They must be clean and leakproof. Through repeated bendings, the nose wire (A-14) might become broken. When it does, replace the mask. The seating of the exhalation valve should be checked before each flight. An improperly seated exhalation valve will admit air upon inhalation. A system can be in perfect working order, and the mask adjusted to a leakproof fit, but let the exhalation valve fail to stop the admittance of outside air into the mask and the entire system, working doubletime, could not stop the effects of hypoxia.

CLEANING INSTRUCTIONS FOR OXYGEN MASKS

It is necessary that adequate attention be given by squadrons to the proper fitting of oxygen masks and their maintenance in a sanitary condition.

New masks and masks already in service have been found to contain a crystalline-like substance which could result in the mask becoming inoperative. The above condition can recur and therefore a close, continuing surveillance of all masks in service is required. Remove the breathing tube and clean the interior with C/120 soap and water utilizing a suitable test tube brush approximately 1 1/2 inches in diameter. Clean all the mask and particularly the ducting leading to the inlet valve ports in accordance with the instructions in *Aviation Clothing and Equipment Bulletin* No. 27-54.

MASK-MOUNTED OXYGEN REGULATOR

The mask-mounted oxygen breathing regulator is personnel mounted and is used both in the inflight and bailout or emergency condition. The regulator is so designed that with an inlet pressure of 40 to 90 p.s.i. it will deliver 100 percent oxygen automatically to the user, between the altitudes of 0 to 50,000 feet. The mask mounted regulator is shown in figure 14-16. This regulator assembly weighs 4 ounces and is approximately 3 inches in length and 2 -1/2 inches in width.

Installation

The mask mounted oxygen breathing regulator is designed to integrate with the A-13A oxygen mask. Instructions for attaching the mask mounted regulator to the A-13A oxygen mask follows:

1. Replace existent A-13A mask breathing tube with the miniature breathing regulator by inserting the outlet of the regulator into the mask inlet port. Clamp the regulator to the mask with the hose clamp provided.
2. Connect the oxygen hose to the oxygen inlet supply port of the regulator.
3. The oxygen hose contains four wire conductors fabricated into the wall of the hose. These wires emerge from the regulator end of the hose as two cables. The cable containing the red and green conductors is attached directly to the mask microphone. The cable containing the black and white conductors is attached to a female jack, which in turn is connected to the existent headset plug.
4. Check the mask mounted regulator and compensated exhalation valve stem to insure that there is no interference during normal flexing, which would cause rubbing and flaking of material into the oxygen regulator demand valve.

OXYGEN HANDLING AND SAFETY PRECAUTIONS

Compressed oxygen and any flammable substance can unite with explosive results, the extent of this danger depending upon the conditions of concentration, pressure, temperature, and confinement. The main ingredient for spontaneous combustion lies in the attainment of a burning temperature. (The temperature at which a material will burn.) Applied concentrations of pure oxygen in an enclosed area where burnable material is present will result in an explosion. Danger exists in the accumulation of heat when the heat of a rapidly oxidizing hydrocarbon is unable to be carried off normally. This condition generates an excessive amount of heat which is capable of bursting into flame with great force and heat, depending on the kind of material affected and its area of confinement.

Oxygen while not flammable in itself is the principal supporter of combustion; and since concentrated or pure oxygen greatly intensifies burning or the oxidation of any hydrocarbon, it is easy to understand the seriousness of the situation when the oxygen pressure is increased. Certain hydrocarbons are naturally more susceptible to burning than others; and when pressurized oxygen gas is carelessly sprayed on quantities of volatile liquids or paste, the reaction is one of accelerated oxidation. The oxidation is accelerated at such a tremendous rate that the flashpoint of the material is reached almost instantly, and an explosion equal to the energy of TNT results.

KEEP OIL AND GREASE AWAY FROM OXYGEN AND OXYGEN EQUIPMENT. This is the primary rule to remember. It implies every conceivable precaution to be taken when a man is working in the shop or in an airplane. Sometimes danger is not apparent until a badly

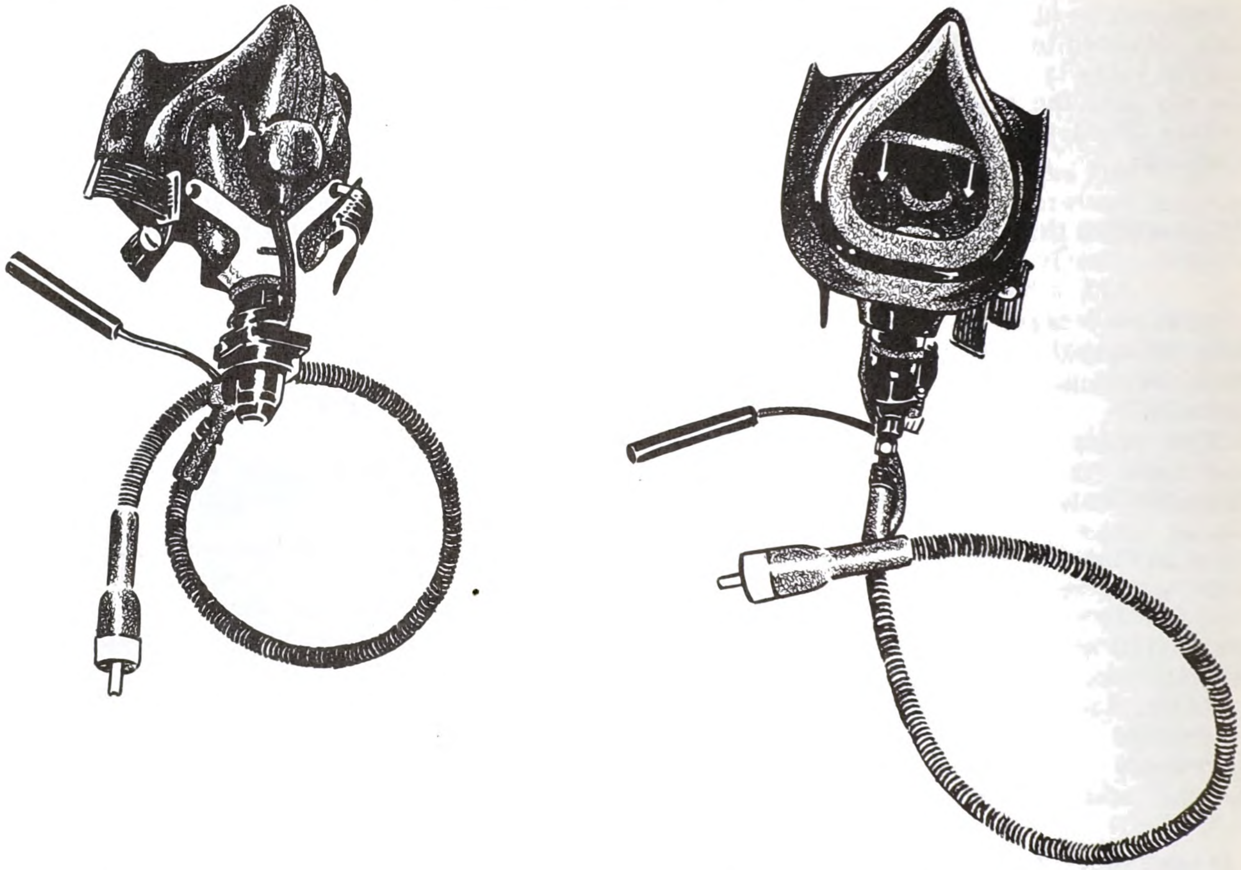


Figure 14-16.—Two views of the A-13A oxygen mask with the mask-mounted oxygen regulator.

flexed and weakened high-pressure line breaks while transferring oxygen in the fuselage of a dirty and oily aircraft. Look for a place where oil and grease may accumulate or collect, and take remedial action to prevent its coming in contact with oxygen. In working with oxygen, it is easy to overlook troublesome areas and become careless. Either keep the filler lines clean and clear or keep oxygen away from such lines.

A list of general safety precuations follows:

1. When attaching an oxygen transfer line to an aircraft system, always make certain the connections are clean, dry, and in good condition before cascading or pumping oxygen.
2. When cascading or pumping oxygen into a system, have someone standing by who can positively shut off the flow in the event of an emergency.
3. Handle cylinders carefully and never drop or bump them.
4. Never use cylinders as rollers for moving heavy equipment.
5. Do not drag or slide cylinders across a deck or the ground.
6. Never mix oxygen with other gases.
7. Never purge an aircraft oxygen system with any gas other than bone-dry water-pumped air or nitrogen. After purging always charge the system with pure oxygen, testing it for odor.
8. Never completely expend the supply of oxygen from a cylinder. Always leave a residual pressure in excess of 15 p.s.i.
9. Do not leave oxygen cylinders near any extreme source of heat.
10. Never fill a lower pressure capacity cylinder without an approved pressure reducing valve.
11. Never use any piece of equipment before understanding its purpose and use.
12. Always check the latest hydrostatic test data stamped on the neck of a cylinder.
13. Always check to make certain the cylinder has been tested for chlorinated hydrocarbons.
14. Never overfill a system.

15. Never leave a trailer cascading system turned on after use.
16. Never leave filling connections exposed to the weather.
17. Never set a filling connection down on the deck or ground.
18. Once pressure is on a flexible filling line never let go of it.
19. Always replace protective thread and end-of-line caps.
20. Never use oxygen filler lines for any gas other than pure dry oxygen, nitrogen, or water pumped dry air. (Water pumped air does not contain the slightest trace of oil or grease, and is usually more difficult to obtain than the nitrogen.)
21. Never use anything but an approved cleaning agent for cleaning external oxygen fittings.
22. Never permit the use of electromagnets in handling oxygen cylinders.
23. Never hoist oxygen cylinders with rope or chain slings. Handle with cranes and specially built cradles, using cable straps to protect them from shifting.
24. When transporting in trucks, storage cylinders should be securely fastened together in an upright position.
25. Protect stored cylinders from excessive temperatures. (Maximum temperature 130° F.)
26. Protect cylinders from the direct rays of the sun.
27. In winter protect cylinders from snow and the formation of ice.
28. Keep cylinders away from flammable materials.
29. Store empty cylinders separately from the full cylinders.
30. Tag or mark empty cylinders. Cylinders are considered empty when less than 50 p.s.i. of pressure remains.
31. Always replace protective valve caps on storage cylinders when they are not in use.
32. Never use greasy rags or wear greasy clothes, or cosmetics (hair oil, lip salve etc.), when working around oxygen equipment.

There are a number of additional safety precautions to be observed when handling liquid oxygen. Some of these parallel the safety precautions outlined for the handling of gaseous oxygen, however, they are worth repeating to insure against accidents. Any possible danger that may occur is based on these general characteristics of liquid oxygen. First, the rate of combustion of most materials can be greatly increased by liquid oxygen; second, contact with liquid oxygen (-297° F.) can cause severe frostbite and damage to equipment vulnerable to freezing conditions; and third, liquid oxygen, if confined, will eventually evaporate and build up a tremendous pressure which could result in the rupture of the tank in which it is stored. Because of these possibilities, the following safety precautions must be observed:

1. Storage tanks must not be located in the vicinity of gasolines, oils, or any other combustible materials.
2. Smoking will not be permitted for anyone working around liquid oxygen.
3. Oil is not to be used near liquid oxygen equipment where it could possibly come in contact with oxygen itself.
4. Allow for free ventilation in any building in which a storage container is located so that a highly concentrated atmosphere of oxygen will not develop.
5. Do not permit liquid oxygen to flow or become trapped on anything that has oil, fuel, or other combustible materials on it. Also, liquid oxygen should not be permitted to flow near fires, sparks, or other open sources of heat.
6. Do not handle tubes and fittings through which liquid oxygen is flowing with the bare hands.
7. Do not permit liquid oxygen to flow onto any part of the body, clothes, pockets, cuffs, and the like, where it might be trapped.
8. Always be sure that hoses and fittings are dry and clean before allowing liquid oxygen to flow through them. Fittings with moisture on them become frozen in position and cannot change or separate without damage.
9. Do not use rubber hose to transfer liquid oxygen as such hose becomes hard and brittle.
10. Keep the vent valve partially open when the tank is not used to deliver liquid oxygen for some time.
11. When the tank is being filled, be sure that the vent valve is open. Saturated liquid oxygen expands as the pressure is increased and might rupture the tank if it is filled to more than its designed capacity.
12. Disconnect filling or transfer line as soon as the transferring process is completed.

QUIZ

1. For the most protection against impact, the headband of a H-3 helmet should be
   a. attached to the helmet inner liner
   b. supplemented with foam rubber spacers
   c. adjusted to fit snugly
   d. replaced with sheets of cellular polystyrene

2. Sizing pads for the APH-5 helmet are supplied in
   a. two basic configurations with three thicknesses
   b. three basic configurations with two thicknesses
   c. three basic configurations with three thicknesses
   d. configurations and thicknesses that are adjustable

3. The H-3 helmet liner is available in _______ sizes.
   a. 3
   b. 4
   c. 5
   d. 6

4. The H-3 helmet is available in ___ sizes.
   a. 3
   b. 4
   c. 5
   d. 6

5. The H-4 helmet differs from the H-3 in that
   a. the headband is fixed in the H-4
   b. the H-4 has an integrated visor
   c. no liner is worn with the H-4
   d. there is no noticeable difference

6. The APH-5 helmet is available in ___ sizes.
   a. 2
   b. 3
   c. 4
   d. 5

7. The neutral gray visor available for the APH-5 helmet is
   a. darker at the bottom than the top for visibility over the instrument panel
   b. commonly used to simulate night flying conditions in training commands
   c. fixed in one position
   d. available in various densities

8. The type earphone used in the S/PH-1 is the
   a. ANB-M-C1
   b. H-87 A/U
   c. M-3 A/A
   d. wafer type

9. The chin strap of a APH-5 helmet is designed to retain the helmet during escapes at speeds in excess of
   a. 400 m.p.h.
   b. 500 knots
   c. 600 m.p.h.
   d. 700 knots

10. When fitting the APH-5 helmet, if the subject's head is over 6 inches in breadth, use
    a. large size helmet with all thick liners
    b. large size helmet with all thin liners
    c. medium size helmet with all thin liners
    d. medium size helmet with all thick liners

11. The type helmet designed for use in helicopters is the
    a. S/PH-1
    b. H-3
    c. H-4
    d. APH-5

12. When fitting the A-13A oxygen mask to the wearer of an APH-5 helmet, the bayonets are inserted
    a. to the second notch
    b. to the third notch
    c. to the fourth notch
    d. until a leakproof fit is obtained

13. The A-13A oxygen mask may be used at altitudes up to ___ feet.
    a. 37,500
    b. 40,000
    c. 43,000
    d. 44,000

14. The A-13A oxygen mask is equipped with
    a. two plastic inlet valve covers
    b. one pressure compensating exhalation valve
    c. laminar seal
    d. all the above

15. Exhalation trouble in an A-13A oxygen mask usually results from
    a. broken exhalation valve stem
    b. excessive inlet pressure
    c. unseated inhalation valve
    d. dirt on the quick disconnect

16. With caution, the A-14 oxygen mask may be used to altitudes of ___ feet.
    a. 35,000
    b. 37,500
    c. 40,000
    d. 43,000

17. To wash oxygen masks use
    a. distilled water and menthol alcohol
    b. MIL-C-18687 and warm water
    c. mild detergent and a soft brush
    d. oxygen masks are never washed

18. The mask mounted oxygen regulator operates on an inlet pressure of ___ p.s.i.
    a. 0 - 100
    b. 40 - 100
    c. 0 - 90
    d. 40 - 90

19. Liquid oxygen is dangerous
    a. when kept in vented containers
    b. due to extreme low temperature
    c. under pressure in aircraft systems
    d. and is not used in naval aviation

20. The type microphone used in oxygen masks is the
    a. NavAer-C-120
    b. H-87 A/U
    c. ANB-M-C1
    d. M-3 A/A

CHAPTER 15

FLIGHT CLOTHING AND PROTECTIVE EQUIPMENT

Keeping pace with the demands of new developments, articles of clothing worn in flight are becoming more complex. The simple coveralls (light and heavy weight) are used daily in moderate speed and low altitude flying. However, the conditions experienced during high speed and high altitude flight have demanded more than a simple warm covering for the body. Consequently, the nature of flight clothing is progressing into a more overall protective stage which guards against sudden losses of cabin pressure and yet maintains an oxygen pressure range necessary to life.

Besides protection from moderate to severe temperatures there are other more complicated elements and conditions to be considered. The attainment of recent higher speeds and higher altitudes have added greater problems to man's efforts to cope with the elements. To combat the danger of a sudden loss of cabin pressure (explosive decompression), and to extend the limit of high altitude flight, the doctors and engineers of medical research have developed a pressure suit.

The full pressure suit is designed to enclose the entire body completely. Its function is to reproduce automatically a normal environment. The correct percentages of oxygen and air combined with pressure and temperature control permits flights in the upper regions hitherto unattainable.

Classified as protective clothing and not flight clothing, the exposure suit is worn on all overwater flights in cold regions. The outer rubberized form of the suit, gripping snugly around the wrists and neck, prevents water from contacting the body. The head is the only exposed part. A quilted liner worn close to the body (or newly designed 2-piece winter flying suit) provides the necessary warmth. Without this suit, a man could not survive in water colder than 32°F.

This chapter is not designed to introduce all the available articles of flight clothing, but offers instructions on fitting and adjusting those items which need special attention in their initial servicing. The exposure suit, for example, must be individually fitted to the rubber boots. Particular attention must be given to the leg measurements in relation to the available material and the individual's freedom of movement. The protective helmet must be equipped for stability and be made adaptable to the oxygen mask. The anti-g suit might require zipper inserts in the legs to allow for expansion of the internal rubber bladders. To make the suit legs tighter for more effective operation, the leg seams can be taken in.

In the initial fitting of clothes, the decisions revolve around the correct choice of fit which is that of selecting the proper size. However, everyone's measurements do not conform with standard size requirements. In naval aviation, it is the Parachute Rigger's job to make flight and protective clothing fit perfectly.

Occasionally, pilots and aircrewmen request that additional pockets or slings be incorporated in their flight clothing. However, the practice of arbitrarily affixing a sheath knife pocket to the trouser leg of a flight suit might later endanger a smooth and uninterrupted egression. In addition to the possibility of hampering an individual's movements during escape, the suspension lines of the opening parachute might foul in the sheath if it has not been attached properly. Whatever the requests for modifying flight clothing might be, there are four basic factors which must be considered: First, the weather and climatic conditions under which the article will be used; second, the fit of the clothing, since the comfort element depends not only on the type of clothing but also on the proper fitting; and third, appropriateness and safety of the modifications in relation to the purpose of the garment; and finally, the authority for the change.

Flight Clothing

FLIGHT SUITS

The summer flying suit is a lightweight 5-ounce cotton twill cloth, khaki, 1-piece coverall type suit. It has a pocket on the sleeve for pencils and patch pockets on each knee for items of survival. The coveralls can be worn over the anti-g suit (antiblackout suit), but never in lieu of it, since the function of the anti-g suit is designed to prevent blood from leaving the upper parts of the body rather than for the purpose of covering the body.

The summer suit is used more in squadrons operating multiplace and/or multiengine aircraft. All garments of this kind should be treated with a fire-retardant compound for the protection of the pilot and crewmen.

For cold weather or extremely high altitude flights, a 2-piece winter type flight suit has been developed. This coverall type winter flying suit is made with a nylon cloth face, backed with dacron pile and lined with a fire-retardant cotton fabric. This suit does not protect an individual who is submerged in cold water; however, it should be worn under the antiexposure suit.

FLIGHT JACKETS

The summer flying jacket is single breasted, waist length and has a slide fastener front closure. This front closure is protected by a flap which runs beneath the entire length of the slide fastener. The jacket is treated with a fire retardant, has 1 patch type pencil pocket without flaps located on the left sleeve, 4 patch type button closure pockets with flaps located on the right and left breasts and right and left sides at the waist, and a half belt at rear waist. It is khaki colored and made of cotton twill. The summer flying jacket is available in seven sizes: 36, 38, 40, 42, 44, 46, and 48

The intermediate leather flying jacket has knitted wristlets and waistband and a moth repellent treated mouton collar high enough to cover the entire neck region without interfering with the helmet or oxygen mask when the head is turned. There are three pockets in the jacket, all of them in the front. One is a large inside pocket; the other two are outside patch pockets. The intermediate flying jacket is chocolate brown in color. It has a slide fastener closure, is nylon lined, and is available in seven sizes 36, 38, 40, 42, 44, 46, and 48.

BOOTS

Proper boots and socks play a vital part in maintaining safety, efficiency, and comfort in any climate. In all areas boots or high service shoes are better than low quarters, since they give protection from sand insects as well as better support for walking. Furthermore, high shoes or boots are less likely to be lost during bailout.

GLOVES

The indoctrination of flying personnel in the proper use of gloves and mittens is an important responsibility of the PR in charge of personal equipment. Flying personnel should be made to realize that the fingers and hands are more vulnerable to frostbite than any other part of the body, and that frostbite can result in amputation.

REQUISITIONING

Defense Department Forms DD 1150 and 1150A, Request for Issue or Turn-in, are used by aviation activities both ashore and afloat to requisition or turn in materials. Form DD 1150 (white) is used to requisition materials and is prepared in multiple copies. Local requirements determine the number of copies to be prepared. Each class of material must be requisitioned on a separate set of forms. Form DD 1150A (yellow) is used to turn in materials. It must be prepared in multiple copies with each set utilized for only one class of material.

In addition to the above standard forms, there are numerous local type forms in use. These local forms are issued by local supply activities to simplify the process of requisitioning material. However, when local forms are used, the supply activity must complete standard forms on the items issued.

RECORDS AND REPORTS

Records are important for proper accountability of materials and equipment as well as for logging inspections, modifications, and changes. Included among the records that must be kept are Parachute Record Cards, Parachute History Cards, life raft inspection, lifejacket inspection, and the static load tests of aircraft safety belts and shoulder harnesses. Records should also be kept on oxygen regulator bench checks, regulator modification changes, and oxygen cylinder contamination tests. These records are subject to inspection at any time by higher authorities and should be kept accurate and up to date at all times.

FLIGHT CLOTHING REPAIR AND MAINTENANCE

Part of the Parachute Rigger's job is maintaining pilots' and aircrewmen's flight clothing in a serviceable condition. To do this requires a good basic knowledge of the principles involved in tailoring. Parachute Riggers are not expected to construct a suit of clothing from a bolt of material; they are expected, however, to be able to make repairs and alterations.

What are the basic principles involved in tailoring? The first and major requirement is knowing how to sew by machine as well as by hand. Second, a knowledge of the materials and construction of a garment is necessary to the operator in order for him to properly analyze the scope of damage and the steps to be taken to effect a remedy. Third, the ability to apply the knowledge acquired in the other two requirements and which can be accomplished only by practice and experience.

To become proficient at removing and replacing a sleeve or collar on a pair of coveralls without damage to the other parts of the garment, one must practice the actual operation. Tailoring cannot be learned from a book; there are too many different types of clothing and shapes on which to drape them.

Flight clothing is rarely damaged to the extent that a yoke or piece in the suit has to be replaced. The greater percentage of damage which occurs in ripped seams or small tears in the material is easily repairable. Restitching a seam or applying a small patch is no great task; however, the same principles regarding the similarity of materials apply here as well as to the parachute. Always strive to use identical materials regardless of the type of repair.

WARNING: When making an alteration or repair, do not stitch through electrical wiring, rubber bladders, or other similar appendages incorporated in certain types of clothing.

Hand Sewing

Handstitching is seldom done by Parachute Riggers, but there will always remain a need for a hand-held needle application of stitching. Machines are not always readily available and often lack the flexibility inherent in handstitching. Many areas still exist in which the handstitch is the best approach to a repair or an assembling step. Realizing these possibilities, a Parachute Rigger should know how to make and where to use a number of the fundamental handstitches.

DARNING

Small snags and broken threads may sometimes be successfully darned. However, darning should be used on very small damages only. On an item of flight clothing, the snag or broken thread may be repaired by darning across the torn part with fine running stitches, using a fine needle. The thread must be the same color and texture as the material. If possible, use a thread raveled from a seam or the top of a hem of the garment. Smooth out the snag or cut away the broken threads from the damaged area.

To reinforce, begin darning about 1/2 inch beyond the end of the damage. A knot is not necessary as there is no great strain on the darn. Continue sewing with tiny stitches back and forth across the tear, running the rows at right angles to the long dimension of the damage. Keep the rows irregular in length to distribute the strain more evenly. Do not draw the stitches so tightly that the darn puckers. (See fig. 15-1.)

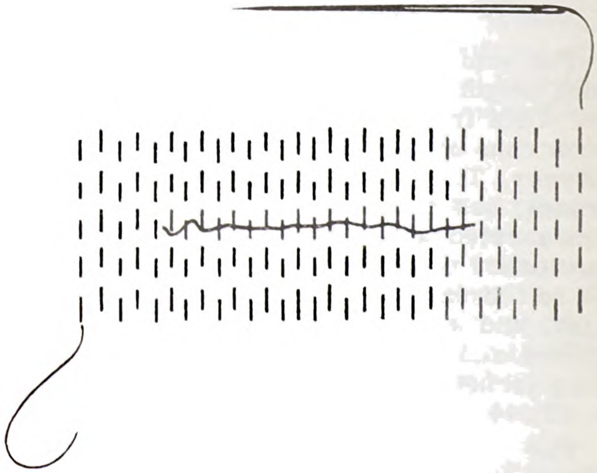


Figure 15-1.—Method of darning a snag or small thread area.

RUNNING STITCH

Small, even amounts of material are taken up and passed over by the needle in the construction of the most versatile of the fundamental stitches. The running stitch is not only used as a temporary stitch as in basting, but as a permanent sewing for the securing of a seam for holding tucks and gathers in lightweight flight clothing. For speed in making this stitch, the needle should be worked in and out of the material several times before being removed entirely. (See fig. 15-2.)

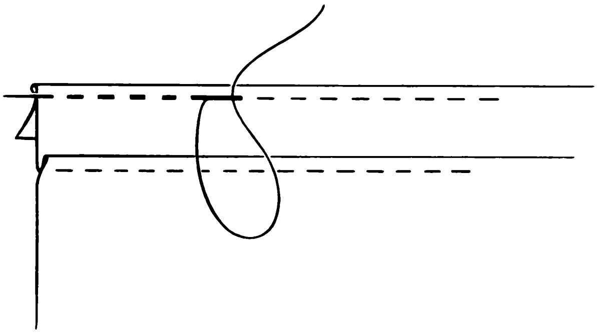


Figure 15-2.—Running stitch.

BACKSTITCH

The backstitch is a very strong stitching in which there is a space between the stitches on the right side of the material. The wrong side, or underside of the material, will show a continuous run of stitches. There are a few variations of the backstitch, some of which close up the spacing of the stitches on the right side of the material. However, the method usually used by the Parachute Rigger is as follows: Insert the needle into the material 1/8 of an inch from the right-hand end of the seam. Working from right to left, and from the right side of the material, bring the needle back through the material, coming out on the right side. The amount or length of cloth taken on the first stitch, which should be three times that covered by the stitch on the right side, will govern the size of all subsequent stitches. They should all be evenly made and spaced.

After completing the first stitch, which is the long stitch on the wrong side, move the needle back and midway to the point where the needle had been previously inserted. Bring the needle out on the right side, taking up three times the amount of material necessary for one stitch on the right side.

Continue taking the long stitch on the wrong side, and the half backstitch on the right side, leaving an equal spacing between stitches. (See fig. 15-3.)

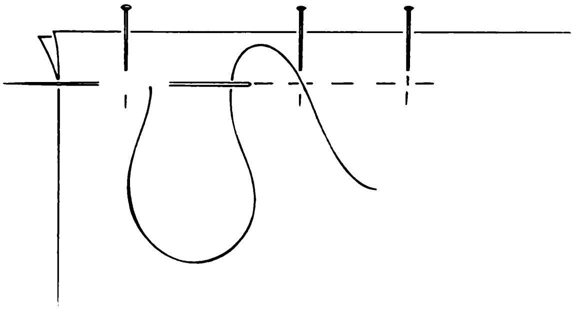


Figure 15-3.—Backstitch.

HEMMING

Hemming is one of the most useful methods of securing the fold or hem turned as the finishing edge of a garment and for securing bindings and facings.

First pin and baste the hem in position on the wrong side of the item. Insert the needle from left to right along the first turned fold, bring the needle out from the fold at the right-hand end of the sewing line. This makes an invisible fastening of the thread. With the needle slanting toward the left shoulder, takeup a few threads of the single thickness of fabric directly under the fold, then bring the needle out through the edge of the fold. Moving to the left a very short distance, take another stitch like the one just completed. This makes a slanting stitch on the right side of the garment, and as the sewing progresses toward the left, a slanting stitch is made on the wrong side of the material.

The greater the amount of material taken up on the needle and the coarser the needle and thread used, the more conspicuous the stitch will be on the right side of the garment. Fasten off the sewing with two or three minute stitches on top of the last one; then slip the needle from left to right in the fold of the material for an inch or two before cutting off the thread.

When hemming, hold the garment so that the second turning or the edge of the hem is in the left hand, over the first finger of that hand, and the bulk of the material is on a table. (See fig. 15-4.)

CATCH STITCHING

In catch stitching the sewing threads cross each other on the wrong side of the material and one row of small stitches shows on the right side. As a general rule, the stitch is used on the

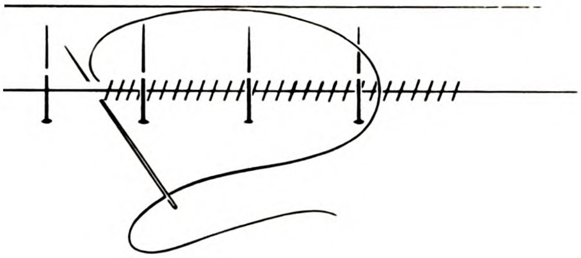


Figure 15-4.—Hemming.

ong side over unfinished edges in heavy fab- cs, especially wool, where a turned-in edge uld be bulky and unsightly on the right side.

The catch stitch is one of the few handmade itches that is worked from left to right. After raw edge is held in place with pins or basting, sert the needle at the left-hand end of the seam other line of sewing under the edge of the aterial to conceal the knot at the end of the wing thread; then, with the needle held paral- l to the raw edge, take a small stitch through e single thickness of material below the edge. ake the next stitch in the material above the w edge with the needle in the same position, arallel to the cut edge about 1/8 or 1/4 of an ch from and to the right of the first stitch. Take e next stitch below the raw edge and continue ternating the stitches above and below the cut dge. The degree of the angle of the crossed reads is determined by the space between the itches. (See fig. 15-5.)

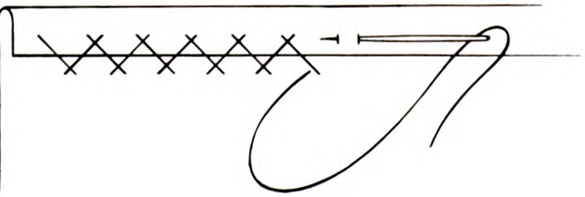


Figure 15-5.—Catch stitch.

OUBLE NEEDLE STITCH

The double needle stitch is comparable to a achine stitch; however, the thread used is not ocked in the material as it is in the 301 machine ype stitch.

In preparing to sew a series of double needle titches, thread each end of a length of cord with n appropriate size needle. Pass one of the needles through the material at the starting point. Draw the thread through until half its length is on each side of the material. An awl can be used to make clean holes for both needles to pass through; however, take care not to damage the material. Predetermine the length of stitch, marking the stitches on the material if necessary. Pass one of the needles through the material, drawing the thread up tight enough to lie flat along the surface. As in starting to lace a shoe, be careful not to draw the first stitch unevenly. Pass the other needle through the same hole in the material and in the opposite direction of the first. Be careful not to catch or cut the thread when passing the needles through the material. Continue making stitches by passing each needle through the hole previously made by the other. (See fig. 15-6.)

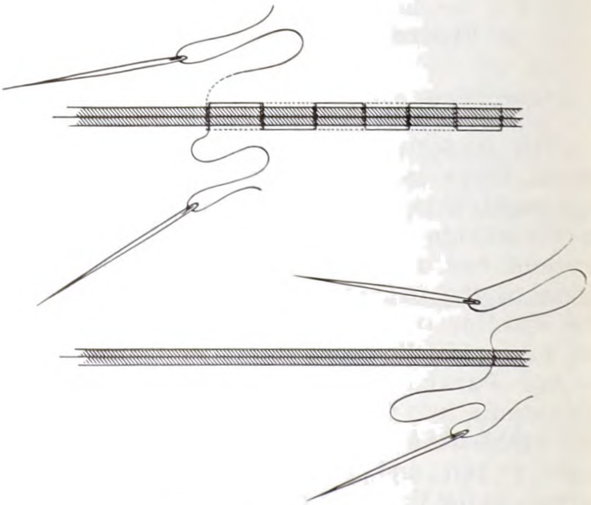


Figure 15-6.—Double needle stitch.

WORKED BUTTONHOLES

Wherever possible, the buttonhole is worked through at least two thicknesses of material. The direction in which the buttonhole is cut depends upon the amount of strain which it must withstand in order that it will not spread open and allow the button to come unfastened. The buttonhole is cut parallel to the front closing on the front of a box pleat in a tailored shirt. On cuffs, neckbands, and on belts, it must be cut at a right angle to the ends so that the buttons will stay in place when subjected to strain.

The position for all buttonholes should be marked before they are worked so that there is no mistake in placement. A paper gage or a tape measure is usually employed for this purpose.

and the exact length of each buttonhole marked with pins. Each slash must be a perfectly straight line, and whenever possible, along the straight thread of material.

Use sharp, pointed, small scissors or button hole scissors to cut the slash. The length of the slash is the diameter plus the thickness of the button. To work buttonholes use a single thread slightly heavier than that used to stitch the garment. Buttonhole twist is preferable for wool materials.

Beginners may find the following method helpful in keeping the depth of the buttonhole stitches uniform. On paper draw a rectangle 1/8 inch wide and as long as necessary for the buttonhole. Pin the paper to the garment at the proper location and stitch on the pencil lines. Tear off the paper. Cut directly between the two long stitched lines and diagonally into the four corners. Work the usual buttonhole stitches, inserting the needle on the lines of stitching when making each stitch.

Start making the buttonhole with a knot at the end of the thread and take the first stitch so that the knot is placed about 1/2 inch from the end of the slash on the right side of the material. If a buttonhole with one fan end and one bar end is to be made, start the work at the inner end of the slash where the bar will be placed. The fan end is located at the outer end where the stem of the button will lie.

Holding the garment with the right side uppermost and the slash over the first finger of the left hand, place the needle 1/2 inch from the cut. Take 3 or 4 shallow overcasting stitches along the nearer edge to keep the two layers of material from slipping apart while the work is progressing; then turn the work around in the hand and place the same number of overcasting stitches over the edges of that side.

Turn the work again to its original position and bring the needle out at the lower right-hand corner of the slash, exactly below the first overcasting stitch and in position to work the buttonhole stitch.

The buttonhole stitches must be slightly deeper than the overcasting stitches in order to cover the latter and to take up enough threads of the material to make a firm buttonhole. The depth of the stitches depends on the texture of the material but is usually from 1/16 inch to 1/8 inch. All stitches must be uniform in size and be evenly spaced.

Take the first stitch by placing the needle in the slash. With the first finger of the left hand hold the thread down as it comes from the material. Then with the right hand draw the double thread from the eye of the needle from right to left placing the thread under the point of the needle to the back or away from you. Draw the needle from the material and backward toward the first finger of the left hand. This places the purl or double knot exactly on the edge of the slash. Repeat this step until the lower edge of the buttonhole has been covered with these protecting stitches and the lefthand corner of the buttonhole has been reached.

If a fan end is to be made, radiate the buttonhole stitches like the spokes of a wheel so that no crowding of stitches takes place at the end. Five stitches are usually sufficient. The work will have to be turned in the hand as these radiating stitches are taken. When the last one is in place, continue working buttonhole stitches along the other side to the end of the slash.

Place two strands of thread across the end of the buttonhole and at right angles to it to make the bar end first. To do this place the needle in the hole made by the first buttonhole stitch, bringing it out in the hole made by the last buttonhole stitch. Repeat this so that at least two strands of thread are across the end, one on top of the other.

Turn the work so that the buttonhole is at right angles to the first finger of the left hand; then, at the left-hand end of the strands of thread, take a blanket stitch by placing the eye of the needle under the strands of thread and over the thread coming from the material, drawing the needle and thread tightly toward the left.

Repeat this step until the strands of thread are completely covered. If preferred, each blanket stitch may be caught in the material. This keeps the purls turned toward the buttonhole. Fasten off the stitch with small stitches on the wrong side of the garment directly under the first buttonhole stitch that was made.

If the double bar buttonhole is desired, work along the first side of the slash as stated; then, instead of making the fan, make one bar before proceeding along the second side of the buttonhole. (See fig. 15-7.)

Removal of Stains

The removal of spots from flight clothing is by no means an easy task or one to be considered lightly. It requires a knowledge of the composition of the material and of the cleaning substance used in order not to damage it irreparably. When

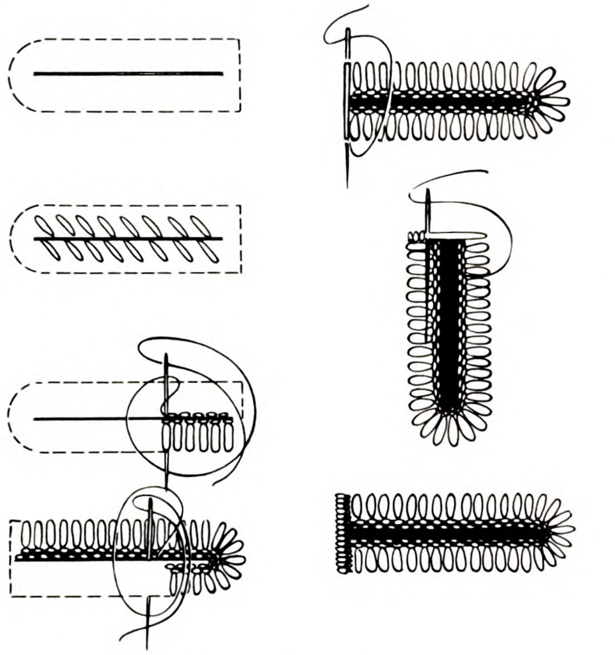


Figure 15-7.—Worked buttonholes with fan and bar ends.

in doubt on these points, one should take the garment to a good dry-cleaning establishment and, if possible, tell them what caused the stain.

Any stain which resists the normal washing process is ordinarily removed by "spotting." This is an art and requires great skill in identifying the nature of the stain and in using the proper agent to remove the stain without damaging or otherwise affecting the material, or leaving a ring around the spot from which the stain was removed.

The spotter must be familiar with textile fibers, sizing materials, the dyestuffs used, the stain or spots encountered, the proper agents or chemicals to be used, and their action upon the fibers and dyes. When testing stains, it is advisable to start with the simplest operations, since certain agents tend to "set" stains, rendering them difficult or impossible to remove.

Table 12-1 (in chapter 12) lists the instructions for removal of stains from the various types of fabric materials.

Application of Fire-Retardant Compound

Fire-retardant compound must be applied to all cotton summer flight clothing now in use or in stock, except those garments procured under contract N383s-89218 and subsequent contracts which are labeled "Launder by Formula S." Garments so labeled have been finished with a durable fire retardant. This treatment should be applied after every laundering of cotton flight clothing requiring treatment. All flight clothing as noted above may be treated as follows on an individual basis.

Remove all grease spots from garments before application of the treatment in regular washing or laundering operations plus a spot cleaning operation, if necessary.

After washing or laundering, the garment should be mechanically extracted or hand wrung to damp dry, then immersed in 6 gallons of water containing 2 pounds of borax, 1 1/2 pounds of boric acid, and 1 1/2 pounds of diammonium phosphate. The garment must be completely submerged. The garment should then be agitated in the solution for approximately 10 minutes at a solution temperature of 100°F.

Remove and mechanically extract to damp dry the garment. Care should be exercised to prevent prolonged exposure to irons or mangles up to 250°F.

Garments with grease stains should be spot cleaned before laundering. Garments which retain grease or other soil not removed by the laundering procedure should be rewashed before fire-retardant treatment is applied.

Extreme care must be exercised in extracting garments before and after application of fire-retardant finish in order to apply and retain sufficient chemicals in garments to give required protection. Prolonged exposure to ironing temperature will impair effectiveness of this treatment. High temperatures may be employed in pressing, provided the water can be removed quickly and the clothing does not remain in contact with the iron or mangle long enough to reach a temperature of 250°F.

Protective Equipment

FULL PRESSURE SUIT

The latest and currently used full pressure suit is designated the Mk IV. The suit consists of four main components—the torso, helmet, gloves, and boots. The Mk IV suit is illustrated in figure 15-8 and is described in the following paragraphs.

The suit is a flexible pressure-tight garment intended for wear by flight personnel in aircraft

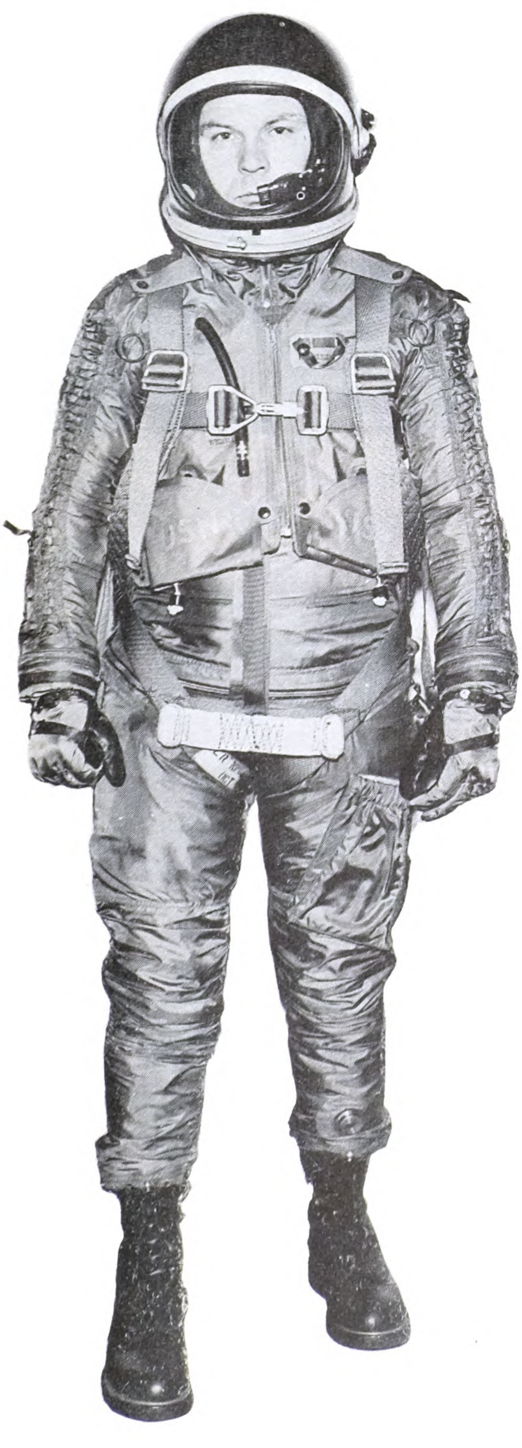


Figure 15-8 (A).—Full pressure suit.

with capabilities of altitudes above 50,000 feet in order to protect them from the effects of low ambient pressures and of explosive decompression. It is also intended to protect the wearer from exposure to extreme ambient and water temperatures, as a result of emergency ditching of an aircraft.

The suit torso is tailored to be a closely fitted coverall type garment encompassing all of the body with exception of the head and hands. A neck ring is the attachment point of the helmet and also acts as a pivot for the head and neck. Incorporated with the helmet are the oxygen breathing regulator and communication system. The gloves extend from the lower one-third of the forearm to the fingertips, and when attached to the sleeve of the torso, form a continuous assembly. The boots worn with the Mk IV pressure suit are Iron Age boots.

Accessory suit equipment consists of an integrated flotation garment with parachute harness and waffle weave underwear for use in cold climates. An anti-g suit (fig. 15-9) is worn when operational requirements warrant its use.

Under normal conditions, with the cockpit adequately pressurized, the pressure suit remains in an unpressurized state and any pressurization that occurs is due to high ventilation flows. The ventilation air is supplied from the aircraft air-conditioning system, monitored through the pilot's manual control valve, and channeled by way of a disconnect into "Trilok ducting," which is an integral part of the torso. This air flows through the ducting and exists at the wrists, ankles, crotch, and periphery of the neck ring. It then flows into the body of the suit so as to remove excess moisture from the body. The air leaves the suit exhaust port and is expelled through the relief port of the suit controller into the cockpit. In addition to ventilating the suit, this air also pressurizes it when required.

The full pressure suit system is designed to respond to and function under several distinct conditions that might be encountered in flight.

1. In normal flight with adequate cabin pressurization, the suit is pressurized only to a very slight extent due to the ventilation air flow.
2. When ambient absolute pressure falls below 3.4 p.s.i. (atmospheric pressure at 35,000 feet), the suit will immediately become pressurized by ventilation air.
3. If the ventilation air is lost, the aircraft oxygen supply will pressurize the suit as well as supply breathing oxygen.
4. In the event of bailout, the emergency oxygen supply will pressurize the suit as well

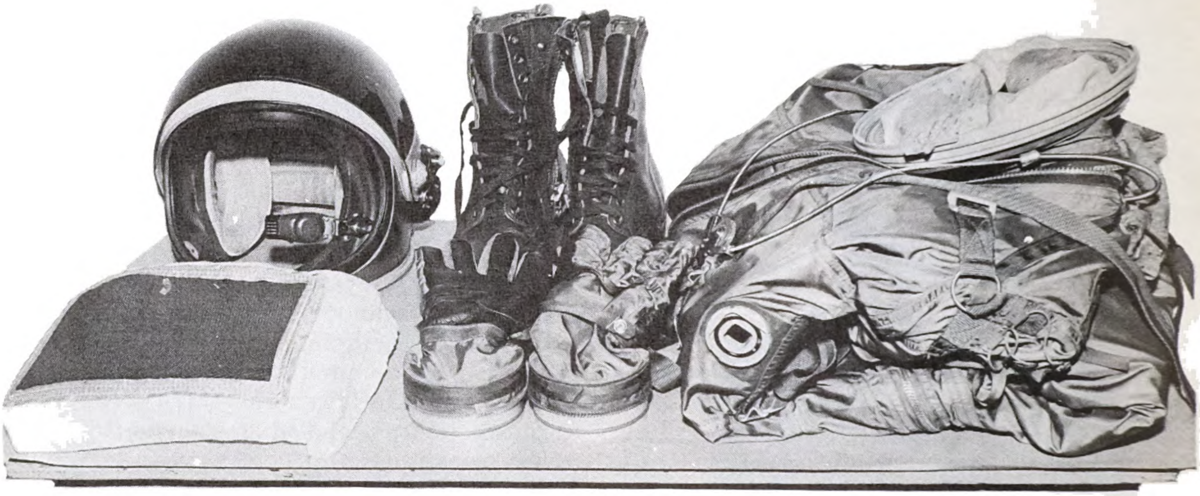


Figure 15-8 (B).—Four basic components.

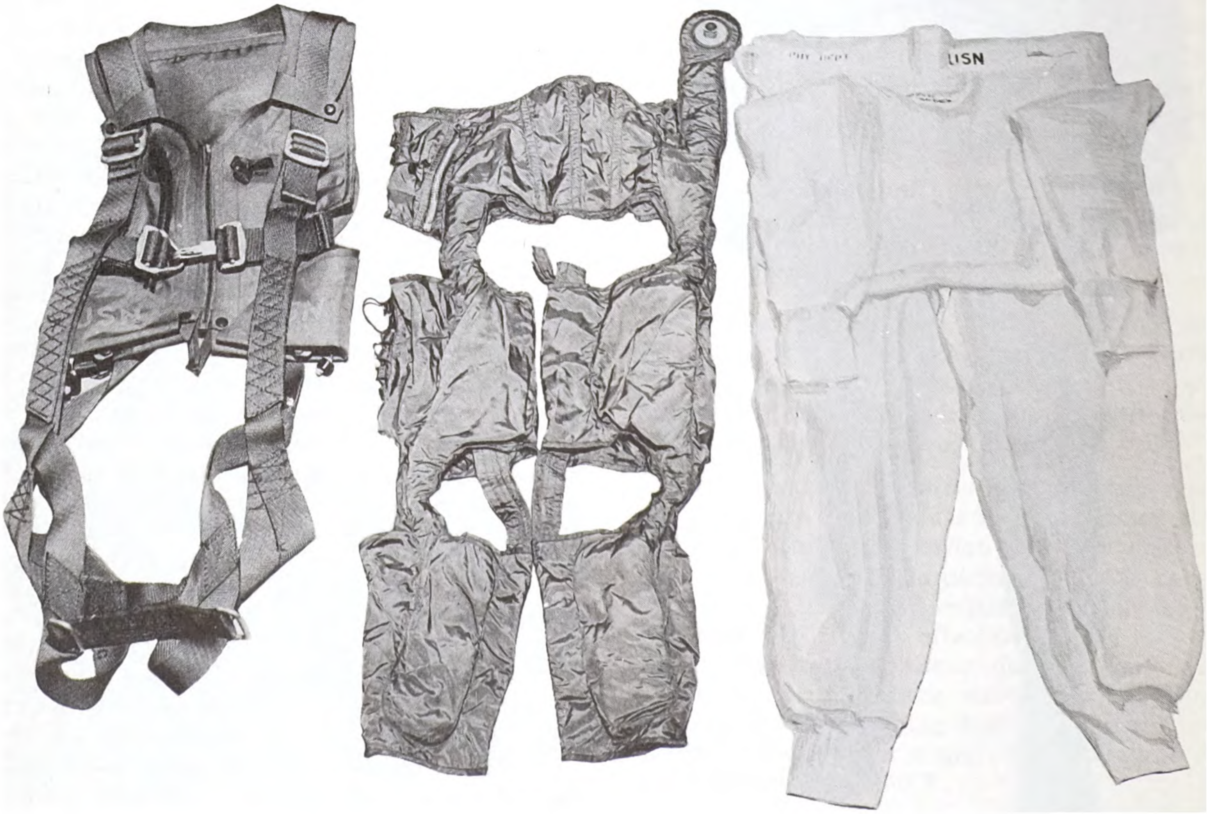


Figure 15-9.—Full pressure suit accessories.

as supply breathing oxygen. The design of this oxygen breathing system is unique in that there is never any need for pressure breathing. While wearing the full pressure suit, one never has to resort to pressure breathing above a slight one inch of water pressure. The freedom afforded by this system of not having a mask tightly cinched across the face and covering the nose and mouth is also an additional pleasant advantage.

TORSO HARNESS SUIT

The integrated torso harness suit is designed for use in Navy aircraft with integrated parachute/restraint harness systems. The suit is shown in figure 15-10.

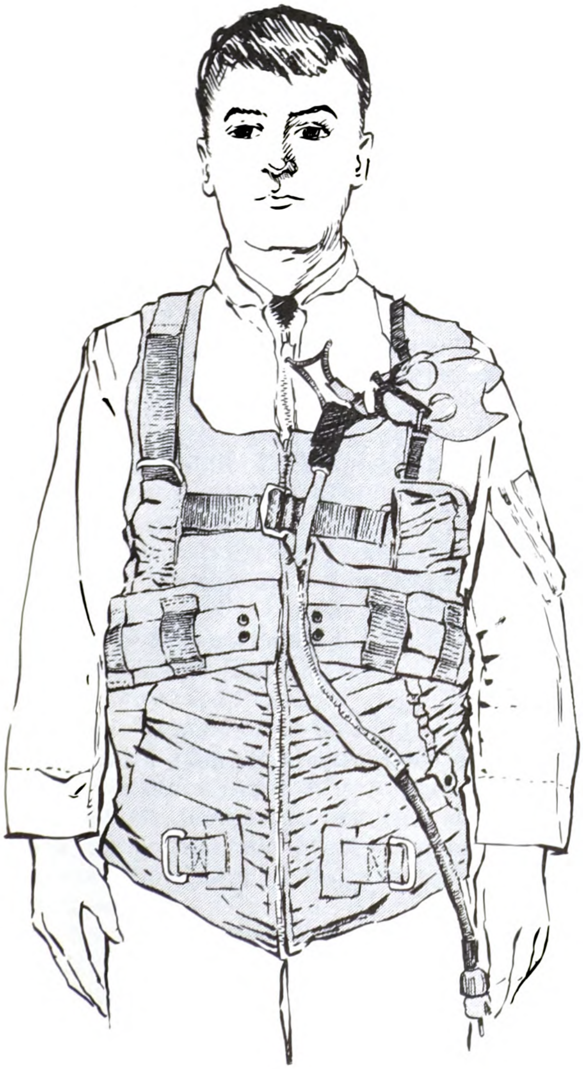


Figure 15-10.—Torso harness suit.

Prior to acceptance of the integrated torso harness suit as a standard item of equipment, an extensive test program was completed to determine its suitability for service usage. As a result of these tests, the integrated parachute harness was proven to be superior to standard harnesses now in use. In comparison with the present restraint and parachute harness system, the integrated system improves comfort, mobility, and retention and provides better donning and doffing features. The new design also reduces the number of straps and reduces overall bulk and weight.

The integrated torso harness suit consists of a sleeveless, legless, fabric garment within which is incorporated the parachute and restraining harness. The garment is closed by means of a slide fastener running the length of the front panel. The harness is secured for a snug fit by an adjustable chest strap located on the upper front of the suit. This feature consists of two harness straps exposed through reinforced outlets in the suit. Adjustments in the harness is taken up through these straps. After the desired adjustment is accomplished, the loose ends of the straps are engaged with the reversible friction adapter for security.

The front panel contains an oxygen hose retainer channel to eliminate the possibility of the oxygen mask being carried away by windblast during the high-speed bailout. The parachute risers and shoulder harness restraint straps attach to the connector links located on the right and left side of the upper chest. The aircraft lap belt attachments engage the two connectors which are located on the lower front panel at the junction of the upper thigh and lower abdomen.

The front panel also contains an attachment snap on the left shoulder strap for the attachment of the oxygen mask when not in use and a protective flap for the oxygen hose coupling at the junction of the hose.

The suit design is such that donning one garment and subsequently attaching it at four points, the pilot is equipped with a parachute, shoulder harness, lap belt, and pararaft.

Sizing

The torso harness suit provides restraint during both normal operation and emergencies, proper sizing to the individual is mandatory to obtain maximum protection. To assist in sizing, the measurements should be taken from the individual, following the data listed in table 15-1. Upon determination of the prescribed measurements, refer to the table for size selection.

The individual should then don the suit to determine that the fittings at the chest and main sling that crosses the buttocks are in proper positions. The chest fittings should ride in the fleshy portion of the chest and not be positioned

Table 15-1.--Sizing chart for integrated torso harness suit.

	Chest circ.		Vertical trunk circ.	Waist circ.		Hip circ.		Thigh circ.	
	Min	Max		Min	Max	Min	Max	Min	Max
Small Short	33.0	37.0	61.0	26.0	30.0	34.0	38.0	19.0	23.0
Small Regular	33.0	37.0	64.0	26.0	30.0	34.0	38.0	19.0	23.0
Small Long	33.0	37.0	66.0	26.0	30.0	34.0	38.0	19.0	23.0
Medium Short	35.0	39.0	63.0	28.0	33.0	34.5	39.5	20.0	24.0
Medium Regular	35.0	39.0	65.0	28.0	33.0	34.5	39.5	20.0	24.0
Medium Long	35.0	39.0	67.0	28.0	33.0	34.5	39.5	20.0	24.0
Large Short	37.0	43.0	65.0	32.0	37.0	37.0	42.0	21.0	25.0
Large Regular	37.0	43.0	67.0	32.0	37.0	37.0	42.0	21.0	25.0
Large Long	37.0	43.0	68.0	32.0	37.0	37.0	42.0	21.0	25.0
X Large Short	38.0	45.0	66.0	34.0	40.0	38.5	44.5	22.0	26.5
X Large Regular	38.0	45.0	68.0	34.0	40.0	38.0	44.0	22.0	26.5
X Large Long	38.0	45.0	70.0	34.0	40.0	38.0	44.0	22.0	26.5

NOTES: Chest Circumference.--Nipple level with normal expiration.

Vertical Trunk Circumference.--Over shoulder at base of neck through crotch and over buttock.

Waist Circumference.--At navel level.

Thigh Circumference.--At crotch--at right angles to leg axis.

too high near the collar bone. The main sling should be positioned well beneath the buttocks when the individual is in a seated position rather than behind the individual. Final determination of proper sizing should be made by the individual entering the aircraft cockpit and hooking-up at the four attachment points. The hookup should be made without excessive slack in the restraining harness. It should be noted that utilization of the adjustment feature or the harness can be best made by assuming a squatting position and wriggling the body while taken up on both sides of the adjusting chest straps.

Donning

The integrated torso harness suit is worn as an outer garment over standard flight clothing such as the summer flight suit, anti-g suit, and antiexposure suit. In view of the increased bulk of the antiexposure suit, it is necessary, when this garment is worn, that the individual be fitted with a torso suit generally one size larger than normally used with other flight clothing. The integrated torso harness suit is furnished in 12 sizes.

ANTI-G EQUIPMENT

Anti-g equipment is currently installed in high performance aircraft to counteract the effects of prolonged acceleration on the pilot. The ill effects of such acceleration range from excessive fatigue and decreased alertness to blackout and unconsciousness.

Effects of Acceleration

Though there is no limit to the speed a human being can endure in straight and level flight in an aircraft, changing speed or direction can lead to reactive forces of inertia to which the body has a sharply limited tolerance. In the case of extreme stresses exerted by acceleration of the type met in seat ejection, ditching, or parachute opening shock, the short duration of the acceleration restricts its effects. However, changing the direction of flight often produces prolonged radial acceleration (longer than a second) which can have dangerous effects.

It is generally stated in relation to g suits, that for each unit corresponding to the pull exerted by the earth's gravitational field the force of inertia in acceleration is proportional to the square of the velocity and inversely proportional to the radius of the turn. At 5 g's, for example, the pilot's body is exposed to a force of inertia which increases its "weight" and that of its components five times.

This increased "weight" has many effects. The pilot is pushed down into his seat. His arms and legs feel like lead and manipulation of the controls becomes more difficult. In addition, the extra weight of the viscera (internal organs) causes abdominal and chest discomfort. Most important, however, is the effect on the circulatory system.

At 5 g's the pressure exerted by the column of blood between the head and the heart becomes just about equal to the blood pressure in the arteries. As a result, the pressure supplied by the heart is not great enough to pump an adequate supply of blood to the head. Experiments with relaxed subjects on a centrifuge show that the first symptoms of difficulty appear at 3.5 to 4.0 g's. These symptoms consist primarily of the graying of the visual fields. At slightly higher accelerations, 4.0 to 4.5 g's, blackout occurs. Though the individual retains consciousness, he cannot see. At 4.5 to 5.0 g's he loses consciousness. By straining the muscles of his body to fight these forces of gravity, a pilot can increase his tolerance somewhat. However, if acceleration is significantly greater, these effects still occur.

To counteract these effects, the arterial pressure must be increased above the heart level. At the same time distended vessels and tissue and fluid spaces in the regions below the heart must be restored to normal. This is accomplished by the anti-g suit. With the anti-g system, compressed air is metered to the suit in proportion to the acceleration, and the suit compresses the legs and abdomen of the wearer by an amount proportional to the acceleration Thus, the suit prevents venous pooling in the abdomen and lower extremities and forces blood from the lower to the upper part of the body. This effect increases venous return to the heart and increases resistance to the shifting of blood to the lower limbs. In addition, it causes the diaphragm to be raised and thus decreases the distance between the heart and the eyes and/or the brain. Altogether, it increases the tolerance of the pilot an average of about 2 g's.

Without an anti-g suit, the average pilot can withstand 4.5 to 5.5 g's without losing vision or blacking out. With a suit, he is capable of withstanding 6.0 to 7.0 g's. However, this protection is available only for sustained accelerations of 4 to 5 seconds or longer in maneuvers other than snap maneuvers. Anti-g equipment does not offer protection in snap maneuvers where 10 to 12 g's can be applied in approximately one second. Such brief forces are not as harmful to the body as lesser forces which are sustained for a number of seconds.

Anti-g Suits

The anti-g suit is a coverall of nylon construction which is worn as the only article of outside clothing in warm climates. Its exterior resembles the summer flying suit. Its total weight, including the five plastic coated nylon bladders with connective tubing, is approximately three pounds. (See fig. 15-11.)

The bladders and tubing of the present suit are also made of nylon, but are impregnated and coated with vinyl resin. A coiled wire covered with a nylon screen to prevent abrasion is placed inside the bladders and tubing to keep the bladders from collapsing. There is no rubber in the bladders or tubes. The bladder system is connected on the left side of the suit to a tube which is fitted with a metal male plug. This plugs into the quick-disconnect of the console which is

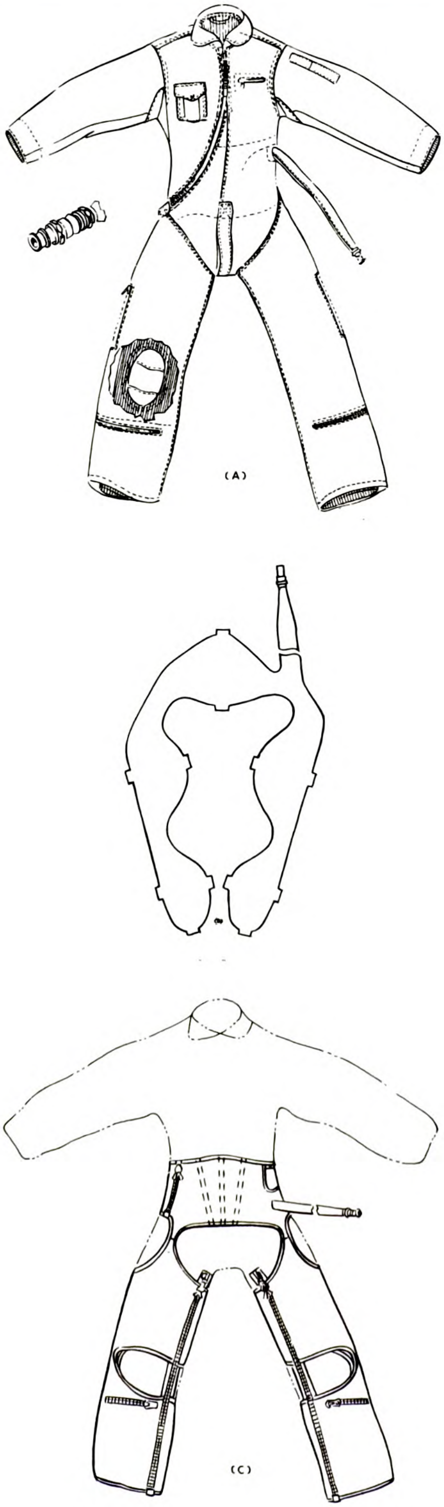


Figure 15-11.—Anti-g suits. (A) Z-2 coverall type (front view); (B) internal bladder arrangement; (C) Z-3 cutaway type (front view).

mounted on the left side of the seat in most aircraft.

Placed in the left breast pocket of the suit is a valve which can be inserted into the mouth of the suit's inflation tube. By inserting the valve in the tube, and blowing air into the bladders, the suit can become a secondary means of buoyancy in conjunction with or in lieu of the lift vest. Before this is done, the legs should be unzipped by the quick release zippers on the upper thighs and snapped together in the back. The anti-g suit was not designed to replace the life jacket in emergencies, but it can be used as a means of secondary flotation. The Z-2 suits are available in 11 sizes ranging from 36 to 44 in long, medium, and short lengths. The Z-3 suits, which are more adjustable, are available in 4 sizes, large and small, in short and long lengths.

SIZING

The suit should fit snugly especially at the waist. The Flight Surgeon, often aided by a Parachute Rigger, instructs and fits personnel. If there is any doubt about the fit, the pilot should sit in the same position as in the plane and inflate the suit orally. The bladders should compress at the waist, calves, and thighs, firmly and evenly. Should difficulty be encountered in properly fitting legs, zipper inserts are available in 3/4-inch and 1-1/2-inch widths to increase the leg sizes. A snug fit means better protection and more comfort under g forces.

MAINTENANCE

If necessary, the Parachute Rigger can decrease or increase the size of the calf or thigh. To inspect for leaks, tears, or weakened fabric, the suit should be inflated to 5 pounds per square inch. The pressure should not fall below 4 pounds in 30 seconds. When not worn, the suit should be hung on a coat hanger. It should be laundered in lukewarm water, washed by hand, and never scrubbed or ironed. Water should never be allowed to get in the bladders. When repairing tears, be careful not to sew through the bladders.

ANTIEXPOSURE SUITS

Mk 4 Constant Wear

Antiexposure suits are designed to be worn on cold weather flights by all personnel. They provide warmth and buoyancy in case of emergency bailout or crash landing at sea. They are more effective on land than they are in the water, but without their protection from cold temperatures and near freezing water the individual would freeze to death quickly. A suit and liner have given protection from exposure for 2 hours in water at 28° F. In subzero weather on land, a suit will give protection for extended periods of time.

Antiexposure suits offer a positive means of buoyancy because of air being inside them. Only when full of water will the suit reach zero buoyancy. For greater ease in swimming, one should get into an upright position and release the entrapped air by pulling the neck seal away from its seat.

The complete antiexposure suit consists of three major components: An outer garment, an insulation liner, and insulated gloves. The cloth of the outer garment is made from a high strength cotton twill which is treated with a water repellant and a fire retardant prior to being coated on one side with a neoprene base compound. When the suit is assembled, the coated side is on the inside of the suit. The suit's wrist and neck seals are fabricated with an elastomer (an elastic rubberlike substance, of natural or synthetic rubber) supported by a network of 100 denier knit nylon yarn.

A quilted material consisting of a layer of wool acetate batting, sandwiched between two layers of preshrunk rayon cloth, is used in the 1-piece liner; a knitted fabric is used in such places as the armpits, wrists, ankles, collar, and g-suit aperture. The 2-piece winter flying suit is currently being used in lieu of the quilted liner. The outer shell material of the gloves is coated; the fabric side is left exposed. An intermediate layer, designed to give warmth, is constructed from a knitted nylon fleece.

The outer suit fabric is permeable to moisture and vapor, but will not admit water. Pockets for gloves and equipment are attached, and the entry and relief openings are equipped with a rolled type seal and slide fasteners The boots, attached to the outer suit are designed with sealed air chambers for cold protection, and are worn with light or medium weight socks.

When the trapped air in the chambers of the boots expands at a high altitude and causes pressure, the air can be vented by actuating a valve on each boot to relieve the pressure. The boots are attached by Parachute Riggers and are furnished in whole sizes from 6 through 13, widths D and EE.

A parka hood, five-finger flying gloves, and a watertight anti-g suit adapter, which is inserted in the end of the hose, comprise the additional items available for use with the suit. (See fig. 15-12.)

DONNING

For full protection and benefit from the suit, the following items of clothing should be worn in addition to the liner and outer garment: Heavy woolen underwear, anti-g suit (if needed), and a pair of socks. When the g-suit is worn, the hose must be passed through the openings provided in the liner and outer section A rubber covering is then passed over the hose, one end extended to the g-suit aperture, while the other end (elastic-like) grips around the outer extremity of the hose near the adapter.

Before putting the suit on, powder the hands and wrists with talc. Talcing rubberized surfaces prevents the skin area, in passing through the garment, from binding and possibly tearing the wristlets.

Entrance is made by spreading the suit front and passing the legs through the entry opening. The g-suit hose is passed through the left side of the suit. Insert arms in sleeves by putting on the left side of the suit first and then the right side. Grasp the neck seal in both hands, spread it apart, and pull the seal over the head. Do not permit the seal to bunch up. It must grip snugly without wrinkles. The same holds true for the wrist seals.

CAUTION: When inserting the feet into the boots, pull on the boots—not on the leg fabric. The entry canopy, by comparison, is more fragile than the material of the outer suit; therefore, upon entry, do not pull on the canopy.

The Mk 4 suit closure is similar to that of the Mk 3 (some of which still remain in service) except that the flap is secured with two slide fasteners. This flap is closed by first zipping the lower fastener and then the upper one.

FITTING THE NECK AND WRISTS SEALS

Each man who is issued the constant wear antiexposure suit must have the wrist and neck seals fitted by a Parachute Rigger. The procedure is as follows:

1. Measure in inches the circumference of the NECK and WRISTS of the man who is to wear the suit.

2. Subtract 2-1/2 inches from each measurement and divide the result by 2. For example, a 15-1/2-inch neck minus 2-1/2 inches equal 13 inches. Dividing 13 inches by 2 results in a value

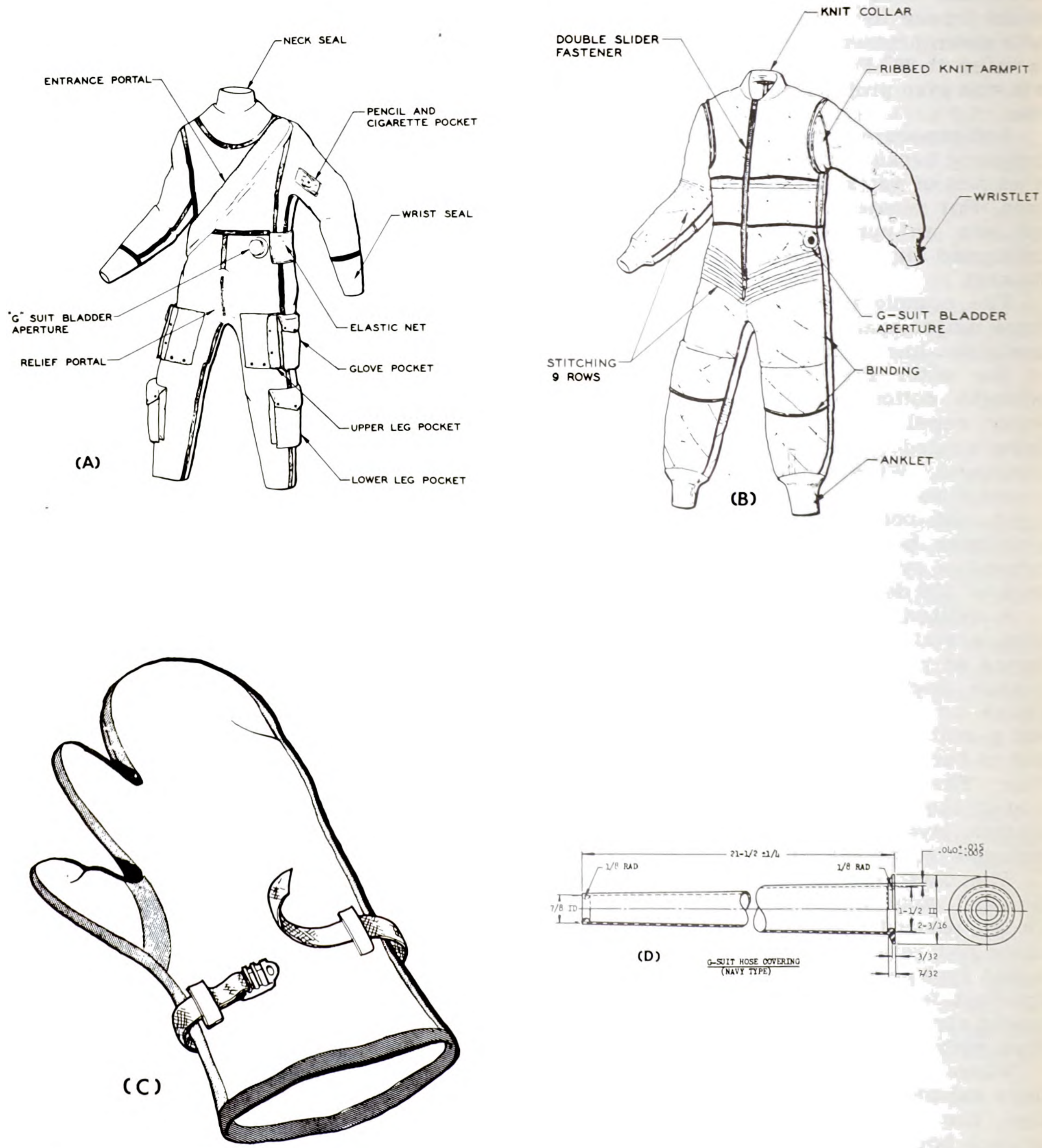


Figure 15-12.—Mk 4 constant wear antiexposure suit.

of 6-1/2 inches. Now lay the suit out flat so that the top edges of the neck seal meet. Keeping the 6-1/2 inches in mind and measuring along a line at the top of the seal which is at a right angle to the centerline of the suit mark off the measurement. (See fig. 15-13.) In applying this measurement, take care to center it, having 3-1/4 inches on either side of the centerline.

3. Keeping the neck seal flat with its edges matched, prepare to make the cut. Starting from left to right or from right to left, whichever side is most convenient, cut along a curved line (dipping below the straight line just marked) and follow the curve of the original edge of the seal. (See fig. 15-13.) Use the appropriate size scissors, which must be sharp to avoid nicking. When cutting, take precautions to prevent the bottom edge from slipping away from the line of cut. Any simple clamping device will hold the edges together firmly. As for measuring and marking the wrist seals, be guided by the centerlines of the sleeves and the original edge line.

FITTING AND ATTACHING BOOTS

The procedure for fitting the boots is as follows:

1. Have the person to be fitted extend his arms over his head while wearing the liner and outer suit. Raise the right leg and bend the knee until the thigh is at right angles to the body. Placing the boot next to the left leg, make a mark at a point 2-1/2 inches below the top edge of the boot. (See fig. 15-14.) Repeat the procedure on the other leg.

By having the individual raise his leg and extend his arms causes the suit leg to be drawn up on the standing leg as much as possible. To this has been added another 2-1/2 inches for cementing the end of each suit leg to is respective boot.

At this point, too much emphasis cannot be placed on the importance of allowing enough slack in the legs of the suit. An insufficient measurement will lead to restricted movements; the restricted movements will strain the material and seams and will damage the suit. IT IS BETTER TO HAVE TOO MUCH SLACK THAN NOT ENOUGH. With the suit off, place a 5-1/2-inch diameter cylinder in a leg deep enough so that the bottom edge coincides with the mark just made during the stretch. Complete the cutting mark around the leg, using the bottom edge of the cylinder as a guide. Do not make a lopsided mark. If the mark on the inside of the leg is lower than that on the outside, the boot may be cemented to the suit leg at a rakish angle. This can be avoided in the beginning by the application of a number of commonsense methods. During the stretching period of the fitting, mark the inside of the leg as well as the outside, using the boot edge as a reference.

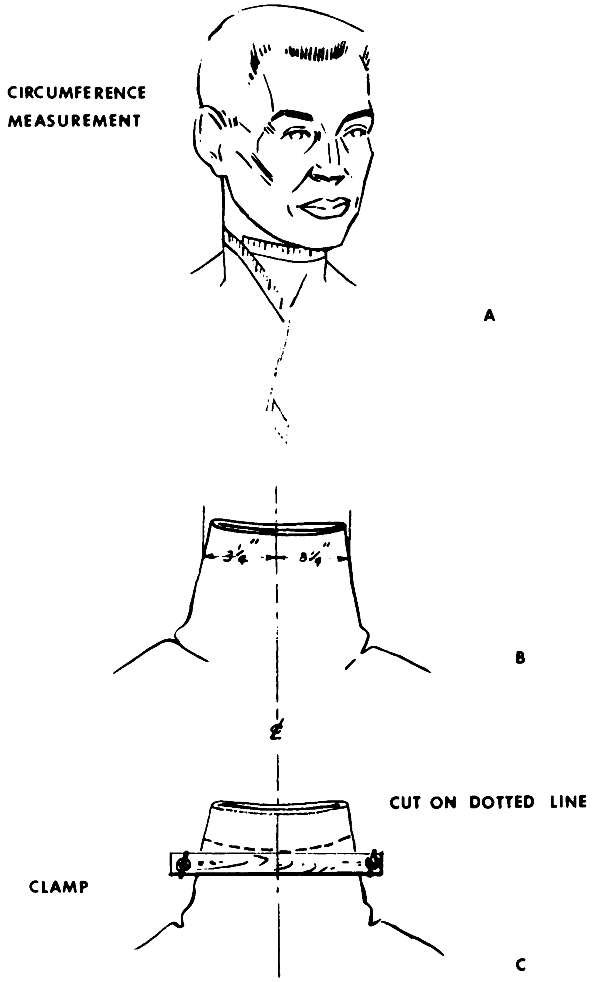


Figure 15-13.—Steps in fitting and marking neck seal.

If an inside leg mark was not made during the fitting, and rather than have the man put the suit on for a second time, measure up from the bottom edge of the leg the same distance as the outside mark indicates to obtain a straight cutting line. However, if the bottom edge of the leg in question is not in an even condition (lopsided in the beginning), the suit will have to be put on again, and an inside leg mark be made relative to the top edge of the boot.

2. Cut off the excess material from each leg.

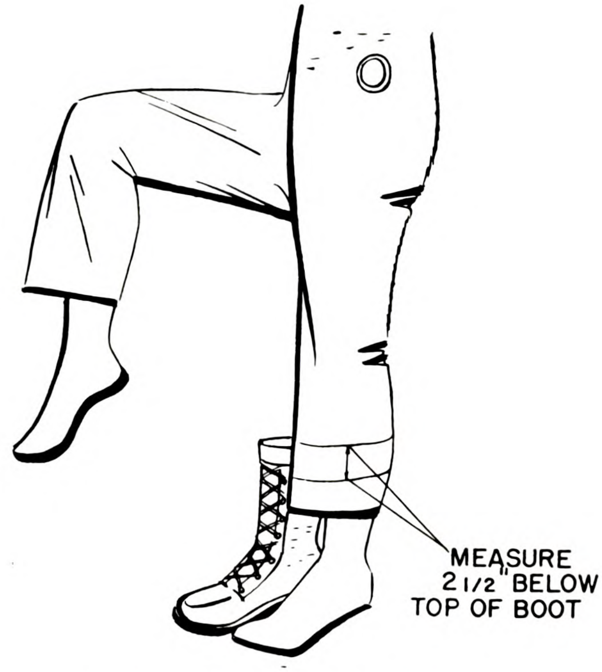


Figure 15-14.—Fitting the boot.

3. Insert a tapered block in the top of each boot, tapered end down, until a snug fit is obtained.

4. Coat the upper 1-1/2-inch portion of the boot exterior with adhesive. (See fig. 15-15 (A).) When dry, apply a second coat, making certain no adhesive is allowed to remain on the blocks.

5. Make a 3-1/2-inch temporary cuff on the suit leg, and apply a coat of adhesive on the RUBBER SIDE for a distance of 1-1/2 inches from the bottom. (See fig. 15-15 (B).)

6. When the adhesive on the boot and suit leg is dry, apply a third coat on the boot top and a second coat to the suit leg.

7. While the final coat of adhesive is still tacky (approximately 8 to 10 minutes) attach the suit leg to the boot so that a 1-1/2-inch lap joint results. (See fig. 15-15 (C).)

CAUTION: BE CERTAIN TO ATTACH THE RIGHT BOOT TO THE RIGHT LEG AND THE LEFT BOOT TO THE LEFT LEG. Use reference marks in aligning the boots (centerline of boots — front and rear with centerline of the suit legs — front and rear). All edges should be closed, pressed together, and rolled firmly with a roller. Make certain that there are no wrinkles or channels in the material during the attachment.

8. Apply a coat of adhesive to the fabric surface to that portion of the side seam which is to be overlapped. (See A, fig. 15-16.) When this coat becomes dry, apply a second coat. At the same time, coat the rubber side of that portion of the side seam that overlaps. (See B, fig. 15-16.) After approximately a half hour, coat both surfaces again. When these become tacky, join the side seam and roll firmly, backing the seam with the hand. Make certain that there are no wrinkles or channels in the material of the seam.

9. Apply a coat of adhesive to all untapered seams. Apply a second coat to the side seam after the first has dried. When the side seam has dried for the second time, apply a third coat. When the adhesive on the side seam becomes tacky, remove the holland cloth from the bias tape. Apply the tape to this seam, cutting off the excess amount at the bottom edge of the lap joint running around the boot.

10. Apply the second coat to the circumferential (around the boots) lap joints, and allow to dry. Apply a third coat of adhesive to only one lap joint. When this becomes tacky, apply the tape, removing the holland cloth. Overlap the end of the tape at least 3/4 of an inch. Use the roller to make a smooth tight finish. Now apply the third and final coat to the circumferential joint of the other boot. When this coat becomes tacky, tape and roll firmly. (See fig. 15-17.) Remove the wooden blocks.

11. Allow one day for the final curing of the neoprene liquid cement.

GENERAL CEMENTING PRECAUTIONS

A well-ventilated working area should be used to permit the adhesive to dry adequately and rapidly. To obtain watertight integrity of the suit, it is always necessary to observe the following rules:

1. Whenever cement is applied to a FABRIC SURFACE, three coats must be applied, allowing each coat to dry a half hour before applying the next.

2. Whenever cement is applied to a RUBBERIZED SURFACE, two coats must be applied allowing a half hour between coats. The cement may be used as long as it wets the surface or is brushable.

3. NEVER SKIMP ON COATS. The minimum number is set forth in repair and other instructions, follow them implicitly. If the correct number of coats are not used, adequate sealing is never accomplished and the effectiveness of the suit is materially decreased.

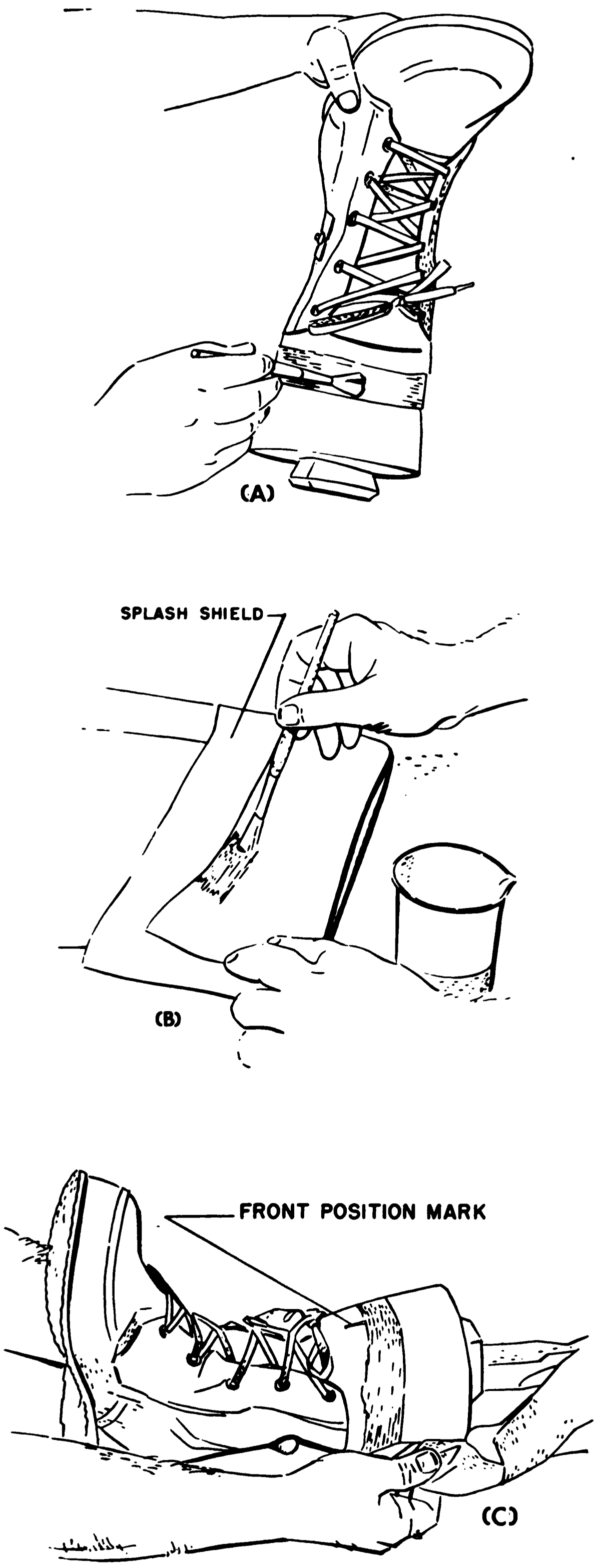


Figure 15-15. —Steps in attaching the boot.

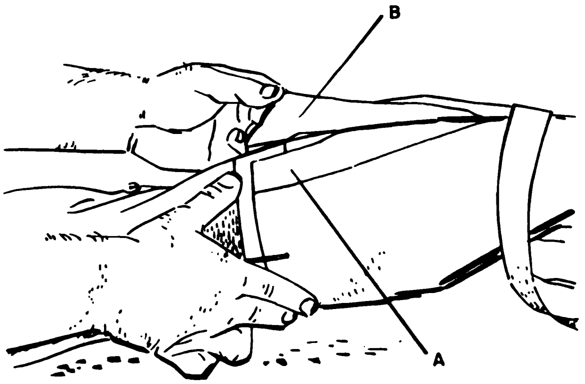


Figure 15-16. —Steps in closing the side seam.

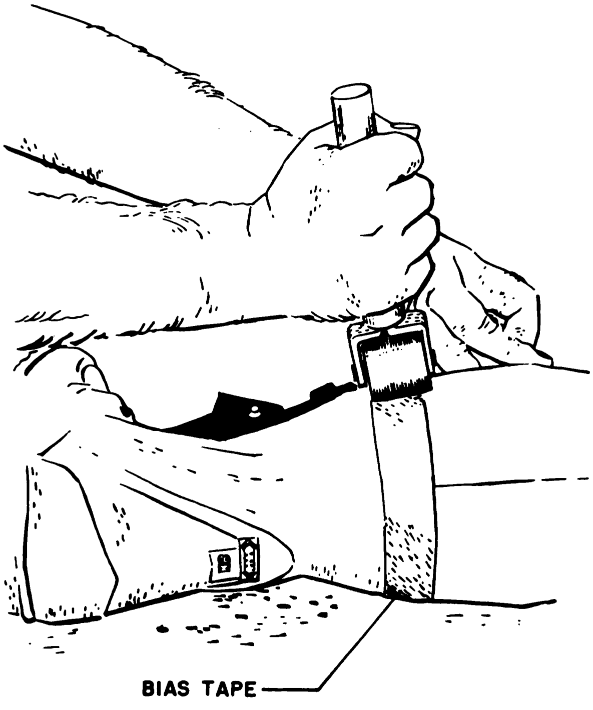


Figure 15-17. —Finishing the boot.

4. Never join two wet surfaces. Always wait until both surfaces become tacky before placing them together.

5. Always roll finished seams or joints with a slow heavy pressure. Unless rolled properly, adequate adhesion is never obtained between the two surfaces.

6. Whenever separating two surfaces that have been cemented, even for an instant, brush ethyl acetate into the area to be separated.

7. When making repairs on the interior of a suit and upon finding it necessary to work on

some other section before the cement extending beyond a closed seam or an applied patch has had a chance to dry thoroughly, powder the area with talc. This will prevent the area from sticking to other parts.

CAUTION: Make certain that talc does not come in contact with areas in need of further repair. TALC WILL NOT TAKE ADHESION. However, should this occur accidentally, dampen a cloth with ethyl acetate and clean the affected area. Allow it to dry thoroughly before applying more adhesive.

CARE AND MAINTENANCE OF SUIT

When not in use, the suit should be kept on a hanger in a cool and well-ventilated place. Never store it in the direct rays of sunlight. Inspect the suit at frequent intervals for damage, especially in the nonfabric areas. Repair materials are provided in the special repair kits.

In repairing minor holes or tears in the outer suits, obtain the suit fabric and cement from the repair kits. Clean the area to be patched and the rubberized side of the patch with solvent (ethyl acetate or naphtha). After the solvent has evaporated, apply an even coat of adhesive to the surfaces. Allow it to dry and then apply another coat.

When this coat has dried, apply the third coat and wait until it becomes tacky. Then affix the patch, pressing it down and rolling it firmly. Do not attempt to make major repairs, such as the replacement of a section. When a suit is severely damaged, obtain a new suit in exchange.

Suit liners can be dry cleaned; however, when such a method is not available, a "hand-wet-cleaning" procedure may be undertaken. This procedure consists of the following steps:

1. Dip the garment in a tub of water (90°F.) to which has been added any neutral synthetic detergent in the proportion of one teaspoon full per gallon of water.
2. Gently SQUEEZE OUT excess cleaning solution. (Do not wring it out.)
3. Place the liner on a flat table or surface and rub with a cellulose sponge or soft bristle brush until clean.
4. Rinse in a tub of cold water.
5. Gently squeeze out excess water.
6. Hang on a wooden hanger so the liner is suspended by the shoulders and let it dry thoroughly. Do not spin-dry it in a machine. Never dry the liner with a heating device.
7. Do not iron or press.

Quick-Donning Antiexposure Coverall

The quick-donning antiexposure coverall provides protection against cold water. This suit is constructed of a lightweight waterproof material, and is designed to be put on easily and quickly before landings at sea.

A suit consists of a singlepiece coverall type garment with attached hood which envelops the body. The face is the only part left uncovered. Mittens are stored in the pockets to provide protection for the hands. The suits are all the same size, and are packaged or folded in convenient carrying pouches for easy stowage in aircraft. (See fig. 15-18.)

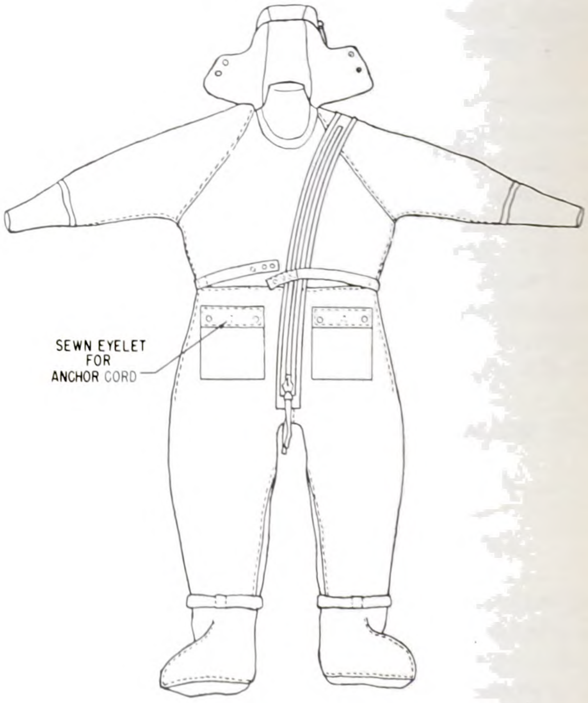


Figure 15-18. —Quick-donning antiexposure coverall.

USE OF THE SUIT

A BuWeps directive lists the areas of the globe where the quick-donning suit should be made available for use.

When it is necessary to abandon an aircraft while over water, the quick-donning exposure suit should be put on over the flying clothes, but under the life vest and parachute harness.

The hood of the suit is made with a sufficient fulness so that it can be worn over the headgear. Use of the hood is optional, as the suit is watertight whether the hood is worn over the head or left folded under the neck closure.

The mittens are normally worn after boarding the life raft. They will provide protection against the cold even though wet.

WEARING INSTRUCTIONS

Follow the steps listed below which outline the procedures for donning the suit:

1. Exercise caution when putting on the suit. Do not damage it by snagging, tearing, or puncturing.
2. Remove the suit from the container and unroll.
3. Grasp it by the hip section and put the feet into the boots. Then pull the suit on over the shoulders while extending each arm, in turn, through the sleeve openings.
4. Pull the neck seal over the head.
5. Adjust the neck properly. Do not allow the undergarments to protrude between the neck seal and neck as this will prevent a watertight, airtight seal.
6. Close the watertight slide fastener.
7. After closing the slide fastener, the entrapped air should be vented out through the neck opening.

When contacting the water, jump in feet first with the arms close to the sides of the body or held together over the head.

INSPECTION

To prolong the life of the suit and maintain its reliability, inspect each garment prior to issue and every 60 days thereafter. The inspection rules follow:

1. Inspect for cracks, tears, holes, and seam separation; defective snap fasteners, buckles, slide fastener, webbings; and deterioration from foreign substances.
2. Make all inspections on a smooth surface, free from harmful agents.
3. Defective suits are returned for repair to overhaul activities.

LIFE VESTS AND PRESERVERS

Mk 2 Life Vest

The Mk 2 pneumatic life vest was designed to be comfortable when worn in flight. To accomplish this, it is worn in its deflated state which permits the wearer all the freedom of movement necessary for the performance of his duty. When inflated, the vest must give adequate and properly distributed buoyancy. Fully inflated, the vest will support a minimum buoyancy of 30 pounds.

An important feature of the vest's supporting qualities is that its neck portion maintains the wearer's head above the surface while the harness suspends him vertically in the water. Since the vest is self righting when properly worn and adjusted, it will always float the wearer in the safest position with his head out of the water. As a further aid to rescue, small tabs and pockets are fashioned to the vest's front lobes for holding signaling equipment and shark repellent.

The body of the vest is fabricated from chloroprene coated nylon fabric. The vest is made in three independent compartments. The inside and outside compartments are inflated by carbon dioxide gas, and the middle compartment is inflated orally through an oral inflation valve and tube.

Deflation of the CO_2 compartments can be accomplished only by removing the CO_2 inflator caps. The air compartment is deflated by depressing the oral inflation valve. A nylon webbing harness, complete with adjusting and fastening devices, maintains the vest position on the wearer's body. Study figure 15-19.

BUOYANCY

When the two CO_2 compartments are inflated (from the standard 8-gram cylinders), the buoyant force (lift) of the vest is 20 pounds. If the center air compartment is also inflated (blown up by mouth), the buoyant force is increased to 30 pounds. This means, in effect, your weight in the water is less than your weight in air by an amount equal to 30 pounds plus the buoyant force of the water.

Since the body, in water, weighs a negligible amount in comparison to its weight in the air, 20 or 30 pounds buoyancy is all that is needed to float the body successfully. It is interesting to note that inflation of the air compartment alone will also produce a 30-pound buoyant effect. A vest inflated to a pressure of 1 1/2 p.s.i. is capable of floating a 30-pound steel weight in fresh water.

DESCRIPTION OF MAJOR COMPONENTS

A brief description of the major components follows:

1. ORAL INFLATOR. The oral inflation

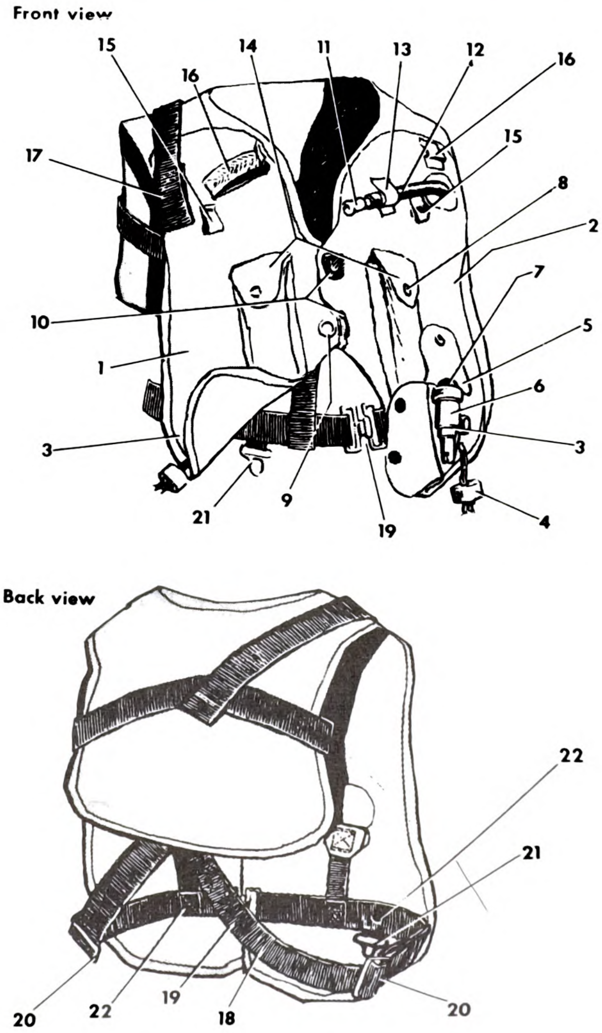


Figure 15-19.—Mk 2 life vest.

1. Right lobe.
2. Left lobe.
3. CO_2 holders
4. CO_2 holder lanyard.
5. CO_2 holder cover.
6. CO_2 cylinder (8-gram capacity)
7. CO_2 holder cap and gasket.
8. Flathead type snaps.
9. Lobe grommets.
10. Lobe fasteners (large curtain type covered).
11. Oral inflation valve.
12. Oral inflation tube
13. Oral inflation tube connector loops.
14. Distress signal pockets.
15. Dye marker tabs.
16. Vest light loops.
17. Hoisting strap.
18. Body harness.
19. Harness fasteners.
20. Adjusters.
21. Pararaft retainer fitting (blanket loop).
22. Snap fasteners.

valve is a self-closing type and is operated by a spring. It can be locked closed by turning a knurled collar until it bears against the depressible valve body.

2. BODY HARNESS. The body harness is easily adjusted to fit all personnel. Its hoisting strap, which is part of the harness, can be used as an auxiliary hoisting sling for helicopter rescue purposes.

3. DYE MARKER TABS. Two tabs, one on the front of each lobe, are provided for attaching dye markers and a shark chaser packet.

4. VEST LIGHT LOOPS. A loop is located on the upper right lobe of the vest for stowing the one-cell life preserver light prior to use. An additional loop is located on the upper left lobe for attachment of the light after the vest has been inflated.

5. ORAL INFLATION CONNECTOR LOOP. This is a loop, on the left lobe, used to prevent excessive movement of the oral inflation connector tube.

6. EQUIPMENT POCKETS. Two pockets, one on each lobe, are used for carrying Mk 13 distress signals and a whistle.

7. CO_2 INFLATOR COVERS. These are flaps used to cover the CO_2 inflators on each lobe of the vest. They prevent the actuating lanyards and the holders from catching on projections.

8. PARARAFT RETAINER FITTING. This fitting is incorporated in the waist strap of the harness for attachment of the snap fitting of either the pararaft or multiplace life raft retainer lanyards.

9. SNAP FASTENER STUD. A stud located under each lobe of the vest to mate with the fastener components on the harness. They prevent upward movement of the lobes when the vest is worn deflated. When the vest is inflated, the fasteners separate and release the vest lobes permitting them to assume their most effective buoyant positions.

The operation of the CO_2 holder is illustrated in figure 15-20.

ACCESSORIES

The survival equipment secured to the life vest is shown in figure 15-21. Use a square knot in tying dye markers and shark chaser packets to the tabs provided. The single cell light is normally stowed and carried in a loop on the right lobe during flight. After entering the water, the light should be transferred to the loop on the left shoulder. The sharp point of the pin

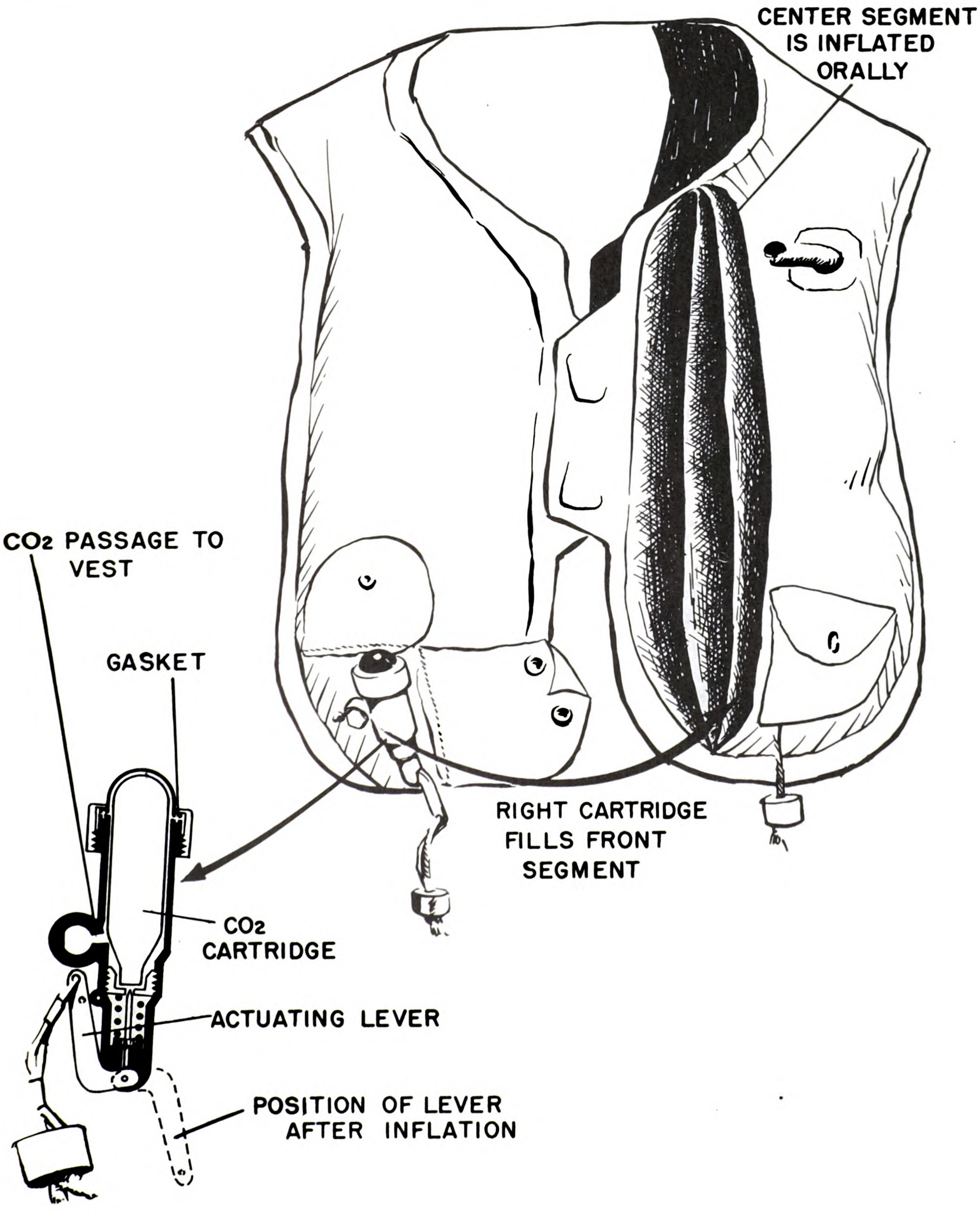

CENTER SEGMENT IS INFLATED ORALLY
CO2 PASSAGE TO VEST
GASKET
RIGHT CARTRIDGE FILLS FRONT SEGMENT
CO2 CARTRIDGE
ACTUATING LEVER
POSITION OF LEVER AFTER INFLATION

Figure 15-20. —Operating principles of the CO_2 holder.

on the light must be blunted and smoothed off BEFORE INSTALLATION to prevent puncturing he vest material.

FITTING

All life vests should be individually fitted o allow enough slack in the harness so it will not bind the wearer after inflation. The simple itting procedure is as follows:

1. Have the wearer put on the vest and secure the harness link fastener, the fasteners which join the lobes, and the fasteners which hold the lobes to the waist belt.
2. Inflate the vest by mouth to its maximum volume.
3. Adjust the harness adapters to obtain a comfortable snug fit.
4. Remove the vest and deflate by depressing he oral inflator valve. Unscrew the valve lock, and the vest is ready for emergency inflation.

NSPECTIONS

Preflight Inspection

Every wearer must be able to determine the condition of his life vest. The following inspection should be conducted by the individual prior to every flight:

1. Inspect all exposed metal parts for evidence of corrosion. If corrosion exists, report he vest for repair and replace it with one that s satisfactory.
2. Observe the inflator holders and the safety wires which secure the actuating levers in a closed position. These should be tied together with 0.016-inch copper wire (spec. QQ-W-341), applied to aid in preventing accidental discharge.
3. Unscrew the inflator holder caps, one at time, observing the condition of the CO_2 ylinders. A punctured seal indicates an empty ylinder. Insert the cylinders in the holders—neck-end down. To be actuated, the seal must be n a contacting position with the piercing pins. The holder caps must be screwed down tightly nd be fitted with gaskets to prevent leakage.
4. Examine for snags, tears, abrasions, or igns of wear in the vest fabric, seams, and arness.
5. Inventory all emergency equipment, noting condition and security. Rusty signals should be replaced, and a cracked whistle is of little alue.
6. Check harness adjustment to insure gainst binding.
7. Compartments of the vest must be deflated completely. Entrapped air will expand at higher altitudes, enlarging the vest and causing restriction and discomfort under the parachute harness.

Periodic Inspection

The following inspections are conducted by Parachute Riggers on all **Mk** 2 life vests PRIOR TO PLACING THEM IN SERVICE, QUARTERLY ON ALL VESTS IN SERVICE and SEMIANNUALLY on the representative samples in stores, chosen at random from the shelves:

1 Inspect all fabric and webbing surfaces for chafing or fraying, rejecting badly worn vests.

2. Inspect all exposed metal parts for evidence of corrosion and replace if necessary. Insure that the large wire spring clamp type fasteners are properly secured to the vest lobe, and that a blanket loop (21, fig. 15-19) is incorporated in the waist belt.

3. Inspect security of all equipment tabs, loops, packets, and covers.

4. For the leakage test, EACH of the THREE compartments of the vest are inflated WITH AIR to a pressure of 2 p.s.i., and the vest hung on a rack for 12 hours. After this period, the allowable loss is 0.50 p.s.i. without rejection of the vest from service. In conducting this test, each compartment is tested individually and compensation should be made for changes in temperature. During these tests, the CO_2 inflators are removed and a low-pressure tire valve core is installed in each threaded manifold for retaining air in the CO_2 compartments. Figure 15-22 illustrates the steps and equipment necessary for replacement of manifold gaskets. Gaskets must be replaced after conducting a leakage test.

The proper functioning of each vest is determined by discharging a CO_2 cylinder into each of the CO_2 compartments in the normal manner. Both CO_2 compartments must be instantly inflated. Deflation of these compartments is accomplished by removing the holder caps so as to insure an unrestricted passage of gas through the holder assemblies.

To expel the entrapped gas completely, press and roll the vest compartments in the direction of the holder assemblies. The oral inflation valve must be held down while working the vest to expel the air from its compartment. Always

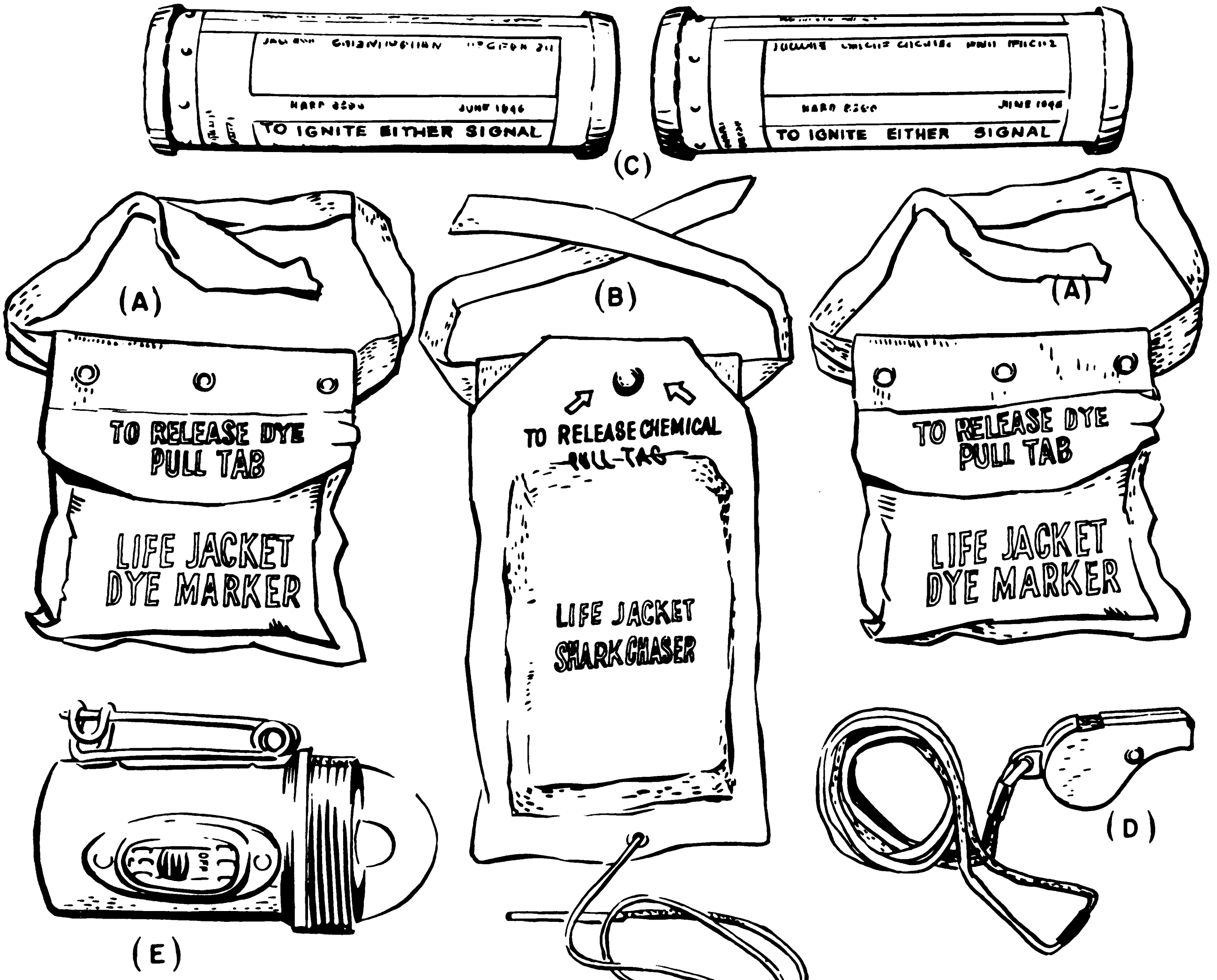


Figure 15-21.—Life vest equipment. (A) Mk 13 Mod 0 distress signals; (B) dye marker packets; (C) shark chaser packet; (D) single cell light; (E) whistle.

expel the air from the center compartment of the vest last.

After a vest has passed the inspection and tests successfully, the person responsible must indicate the date and his name in INDELIBLE INK directly on the fabric of the vest. The record form, approximately 5-1/2 inches by 6 inches, is shown in figure 15-23. The most applicable location for this indelible stamp to be applied is under the collar area where it lies across the back.

MAINTENANCE

Patching

The application of patches to repair holes and tears is accomplished as follows:

1. Cut a scalloped patch of chloroprene-coated nylon vest fabric large enough to extend beyond the damage for a margin of 1 1/2 inches. Place the patch in position over the hole and mark around the patch.

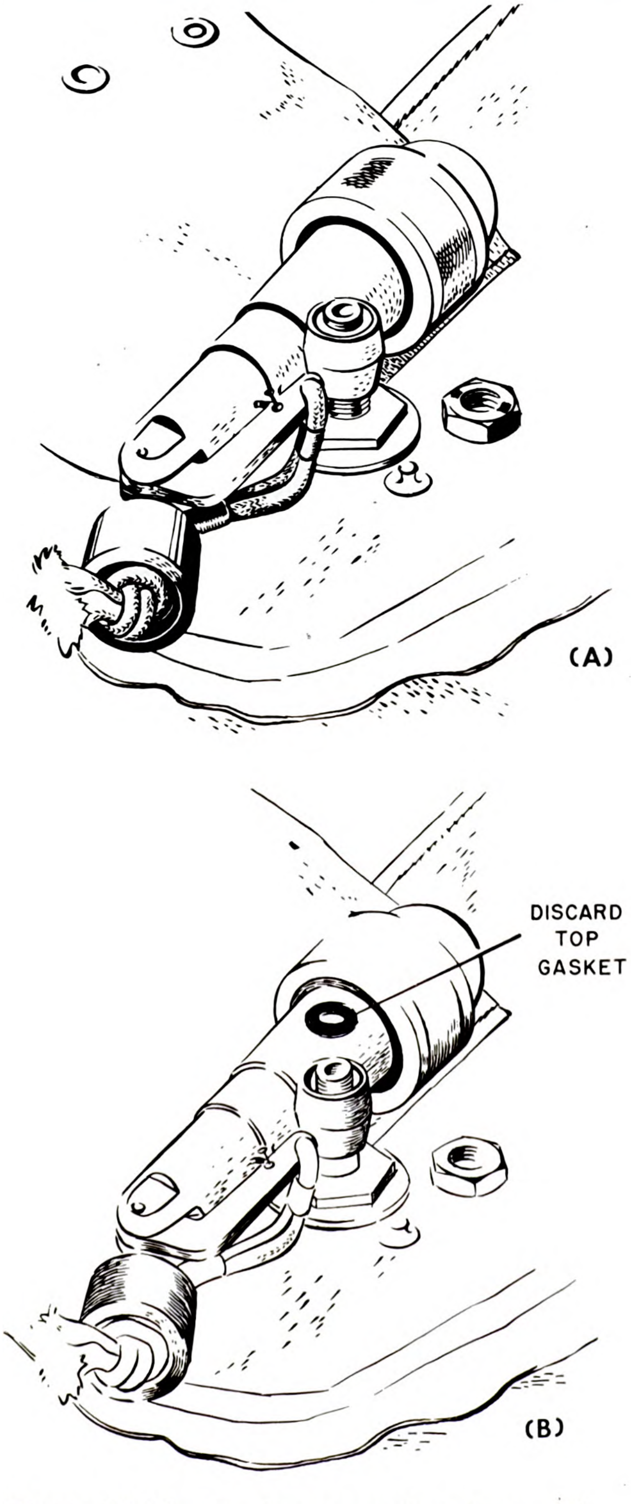


Figure 15-22.—Replacement of gaskets. (A) Remove hexagonal capnut which secures CO_2 inflator to manifold; (B) remove and discard top gasket.

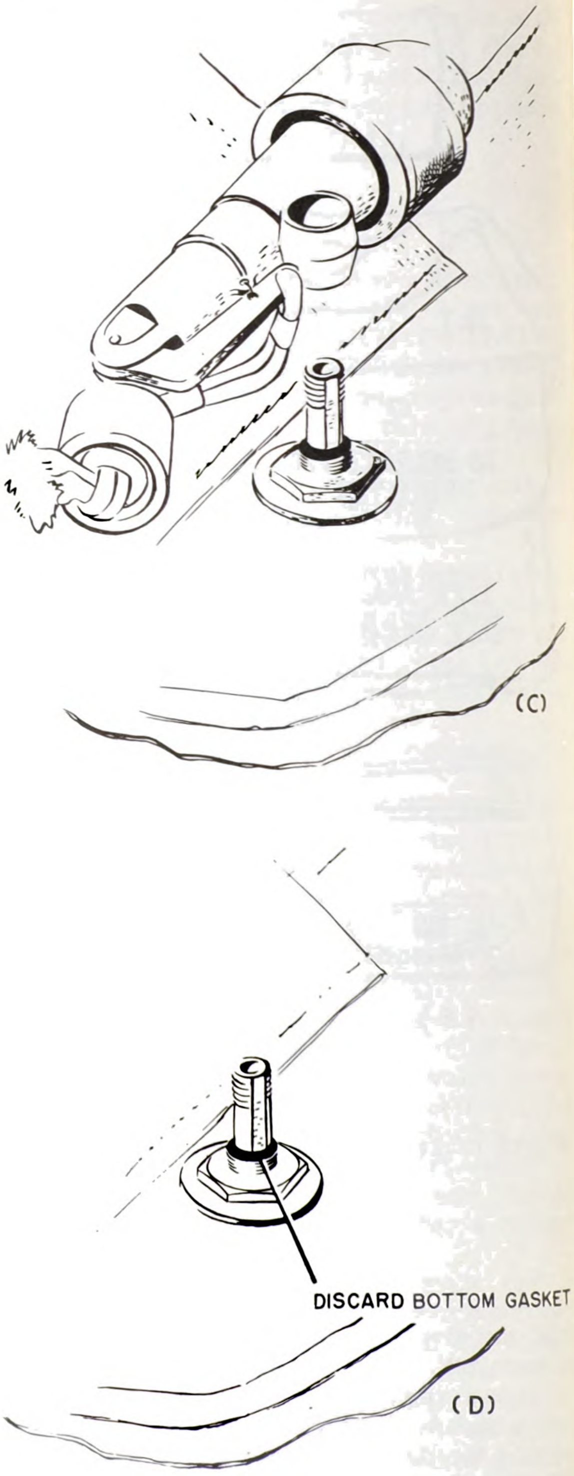


Figure 15-22.—Replacement to gaskets. (C) Remove CO_2 inflator; (D) remove and discard bottom gasket.

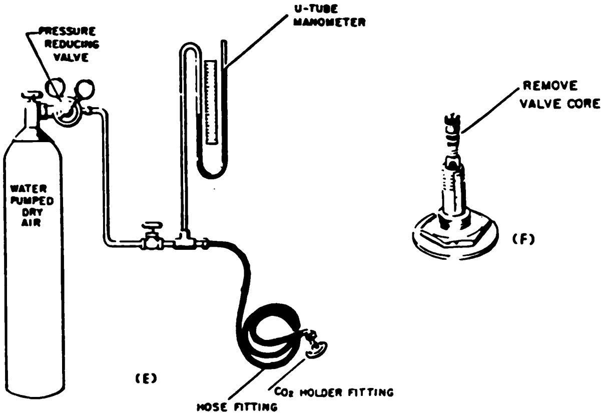
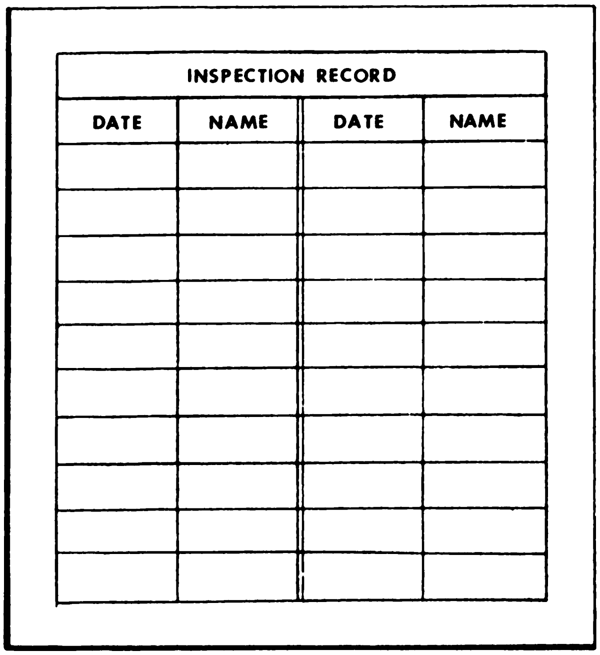


Figure 15-22. —Replacement of gaskets. (E) Install valve core in threaded manifold and inflate CO2 compartments; (F) upon completion of test, remove the valve core. NOTE: Upon removal of valve core: (1) install new bottom gasket (9/32-inch I. D.); (2) replace CO_2 inflator; (3) install new top gasket (11/32-inch I. D.); and (4) re-install assembly and secure hexagon capnut.



INSPECTION RECORD			
DATE	NAME	DATE	NAME

Figure 15-23. —Life vest inspection record card.

2. Clean the marked area and the underside of the patch with aliphatic naphtha (or other suitable safety solvent) and allow it to dry.

3. Apply three coats of cement (conforming to the applicable specification adaptable to chloroprene-coated fabrics) to the surface of the damaged area, allowing ample time for each coat to dry.

4. Apply three coats of cement to the inside of the patch, allowing ample time for the first two coats to dry. When the last coat is tacky, lay the patch over the tear and roll it down, being careful not to trap air between the two cemented surfaces.

Seams

Seams which show signs of opening (loss of adhesion) are repaired in the following manner:

1. Clean the inside of the opened seam with a chloroprene solvent as recommended by the cement manufacturer.

2. Thin a small quantity of cement by adding an equal amount of toluene or a suitable thinner specified by the manufacturer and mix thoroughly. Apply the thinned cement to the washed area on each of the two sides of the seam covering the entire area as much as possible; allow to dry.

3. Apply three more coats of the thinned cement to each side of the seam and one coat of full strength cement to each side of the seam. Allow sufficient time for each coat to dry.

4. When the last of these coats has become tacky, press the seam together and roll it down firmly, being careful not to trap air between the two cemented surfaces.

5. Next, apply four coats of thinned cement and three coats of full strength cement to the outside of the seam.

6. When the last of these coats has become tacky, fold a piece of tape 1 1/2 inches wide conforming to the specifications over the prepared section of the seam with the cemented faces adjoining. Roll the seam to insure the exclusion of air and to obtain a tight bond between surfaces.

Cleaning

The vest may be cleaned with mild soap and water only, followed by a thorough rinsing and drying. For removing old cement, grease, paint, or similar stains from surface areas, use aliphatic naphtha or other suitable safety solvent. When using solvents for this purpose, exercise caution not to dissolve too much of the rubber coating. Always use solvents in well-ventilated surroundings.

Survey

Life vests exceeding a five years storage or service life are surveyed and replaced.

Mk 3C Life Preserver

The Mk 3C life preserver was designed to offer no discomfort to the wearer when worn, uninflated, during flight. Its design provides for instantaneous inflation by means of two self-contained cylinders of CO_2 gas which are mechanically discharged. In addition, the preserver pack is used to carry some essential items of survival equipment. The fully inflated preserver, giving a minimum buoyancy of 60 pounds, is self righting and furnishes an entirely adequate and properly distributed buoyancy to support the wearer vertically in the water.

FLOTATION CELLS

The flotation cells of the Mk 3C preserver are fabricated from chloroprene-coated nylon cloth. The two independent cells are superimposed and joined with equalizing gussets as shown in figure 15-24. Each cell has an oral inflation tube and a CO_2 inflator. Attached to opposite sides of the front of the top cell are a male and female clasp end. The clasp ends are passed through an opening in the folded pack and are joined to secure the cells around the wearer. (An additional clasp is used to hold the preserver pack around the wearer.)

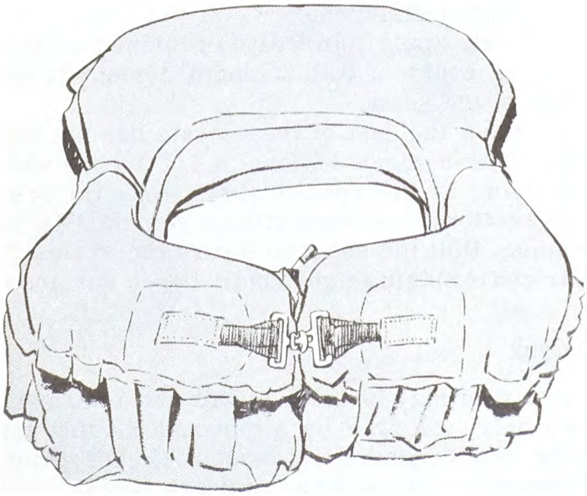


Figure 15-24. —Mk 3C life preserver flotation cells.

CARBON DIOXIDE INFLATOR AND CYLINDERS

Each cell has a CO_2 inflator. The CO_2 cylinder of the inflator is placed in a pocket provided in the pack. (See fig. 15-25.) A lanyard (with a toggle) runs from each inflator, through openings in the pack, so that the toggles are outside the finished pack, within easy grasp of the wearer. Pulling on a toggle discharges a CO_2 cylinder to inflate a cell. When the preserver is inflated, the CO_2 inflator lies between the cells. Two 28-gram CO_2 cylinders are provided in each preserver, one for each CO_2 inflator. Use only identical cylinders for replacement.

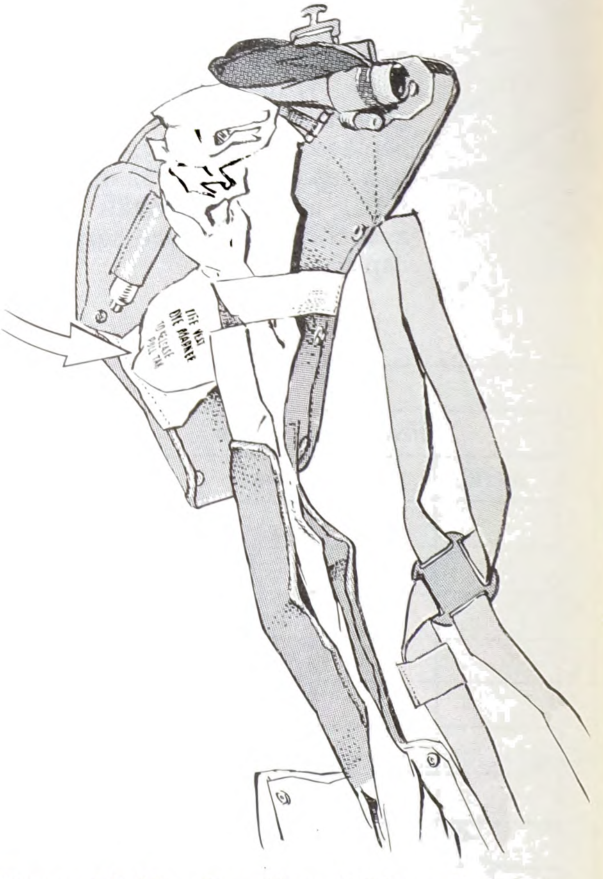


Figure 15-25. —Location of CO_2 cylinder inflator pocket provided on pack.

ORAL INFLATION

Each cell has an oral inflation tube. Each oral inflation tube is supplied with a self-closing valve. To operate the valve, the mouthpiece must first be unlocked by turning the knurled sleeve down. Pressing in on the mouthpiece will open the valve and allow the passage of air to the cell. Release of pressure closes the valve. The valve is then locked by turning the knurled sleeve up against the mouthpiece. Whenever charged CO_2 cylinders are in the preserver, each valve must be locked to prevent accidental loss of pressure.

PRESERVER PACK

The uninflated preserver is contained within the preserver pack. The pack has two pockets for the two distress signals and is also designed to provide means of attachment for two dye markers. The pack opens flat for ease in stowing the preserver. The pack has two retaining webbings to hold the cells to the pack, an adjustment envelope to contain the rear sections of the cells, and envelope flaps to retain the forward sections of the cells. All flaps are provided with snap fasteners for closing except for the envelope flaps which have grommets through which the retaining loop is passed to receive a cotter key. (See fig. 15-26.)

This cotter key through the retaining loop holds the pack closed until the lanyard is pulled to inflate the preserver. The retaining cord, attached to the lanyard, pulls the cotter key and allows the pack to fly open under inflation pressure. The pack is adjustable to the size of the wearer.

ACCESSORIES

The Mk 3C life preserver has two dye marker packets and two Mk 13 Mod 0 distress signals.

FITTING THE PRESERVER

The Mk 3C life preserver should fit the wearer in the manner shown in figures 15-27 and 15-28. The life preserver is marked on the back as to LEFT AND RIGHT sides.

With these marks out, don the preserver as you would a belt and join the two snaps in front to secure the case snugly and comfortably about the waist.

Adjustment is gained by use of the adjusting band on the back of the carrying case. Waist fit should be snug and comfortable but not excessively tight.

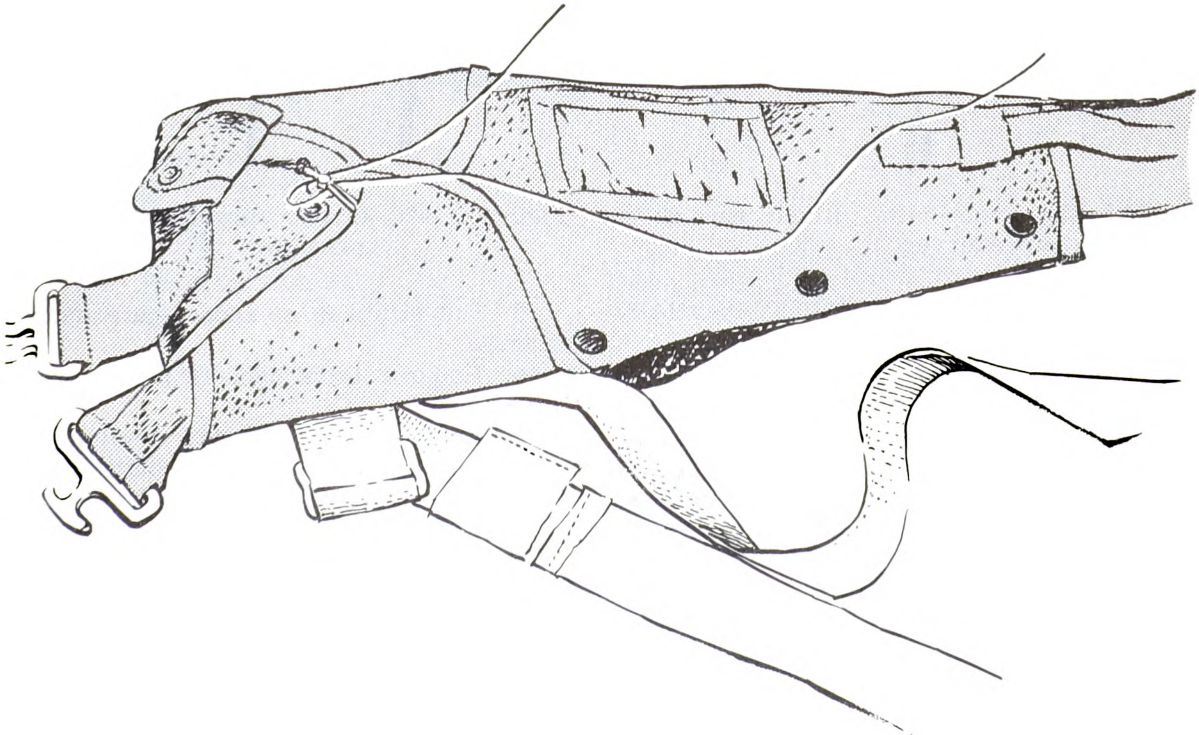
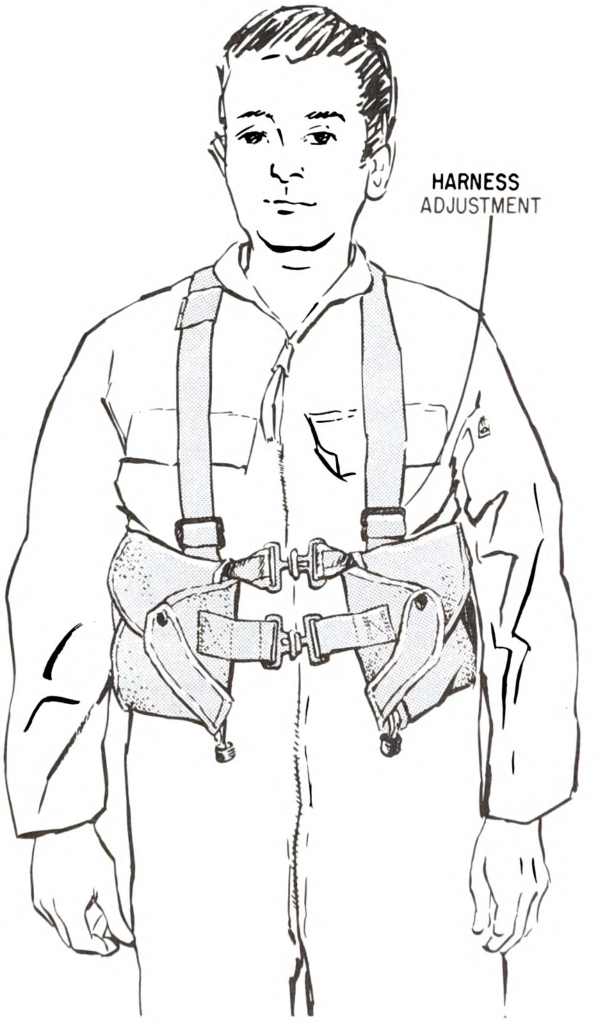


Figure 15-26. —Size A nylon thread passed through holes in cotter key.



igure 15-27.—Front view, illustrating fit of preserver.

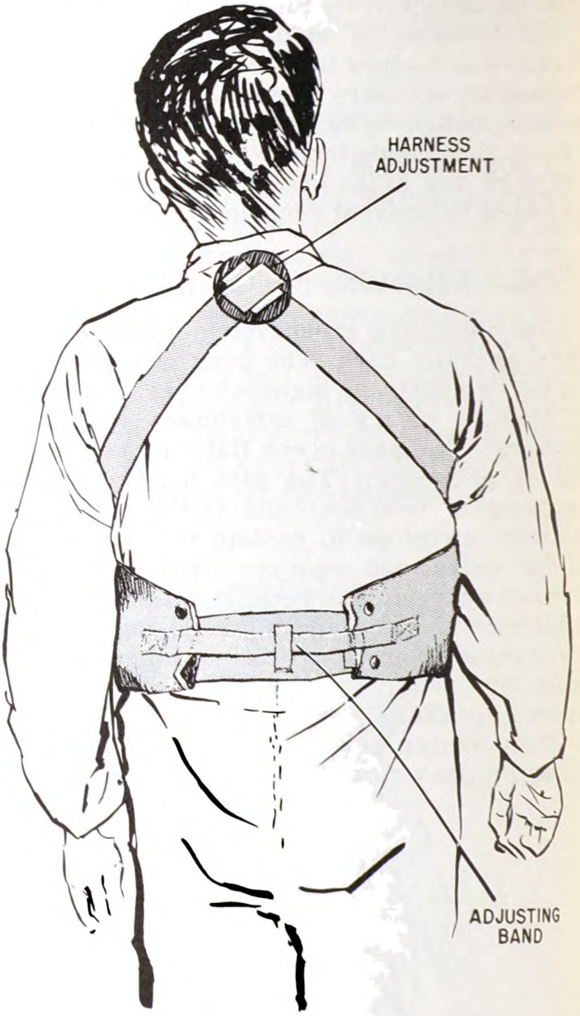


Figure 15-28.—Back view, illustrating fit of preserver.

NTEGRATING THE MK 3C WITH TORSO HAR-ESS SUIT

In accordance with *Aviation Clothing and Sur-ival Equipment Bulletin* 40-57A, the Mk 3C life reserver is to be integrated with the torso har-ess suit. This involves disassembly of the life reserver, making certain modifications, and ttaching the life preserver and torso harness uit together to form an integrated unit.

The procedure for performing this work is utlined in the following paragraphs and illus-rated in figures 15-29 and 15-30.

Disassemble the Mk 3C life preserver as llows:

1. Unfasten snaps of preserver container.
2. Remove flotation cells and center section bric cover.
3. Cut stitching as appropriate and remove harness.
4. Remove flare pockets from containers, if installed.
5. Remove CO_2 cylinder retaining pocket from right-hand container by cutting stitches. NOTE: Retain flare pockets and CO_2 cylinder pocket for reinstallation.

Perform the modification as follows:

1. Cut four pieces of 1 23/32-inch Type VI nylon webbing, each 45 inches in length.
2. Using size E nylon thread, zigzag stitch two of the lengths of webbing together, edge to edge, forming reinforcement (2) in figure 15-29. Cut in two equal length pieces and sear ends.
3. Install snap assembly stud (AN227-56) and post (AN227-57) in each piece.

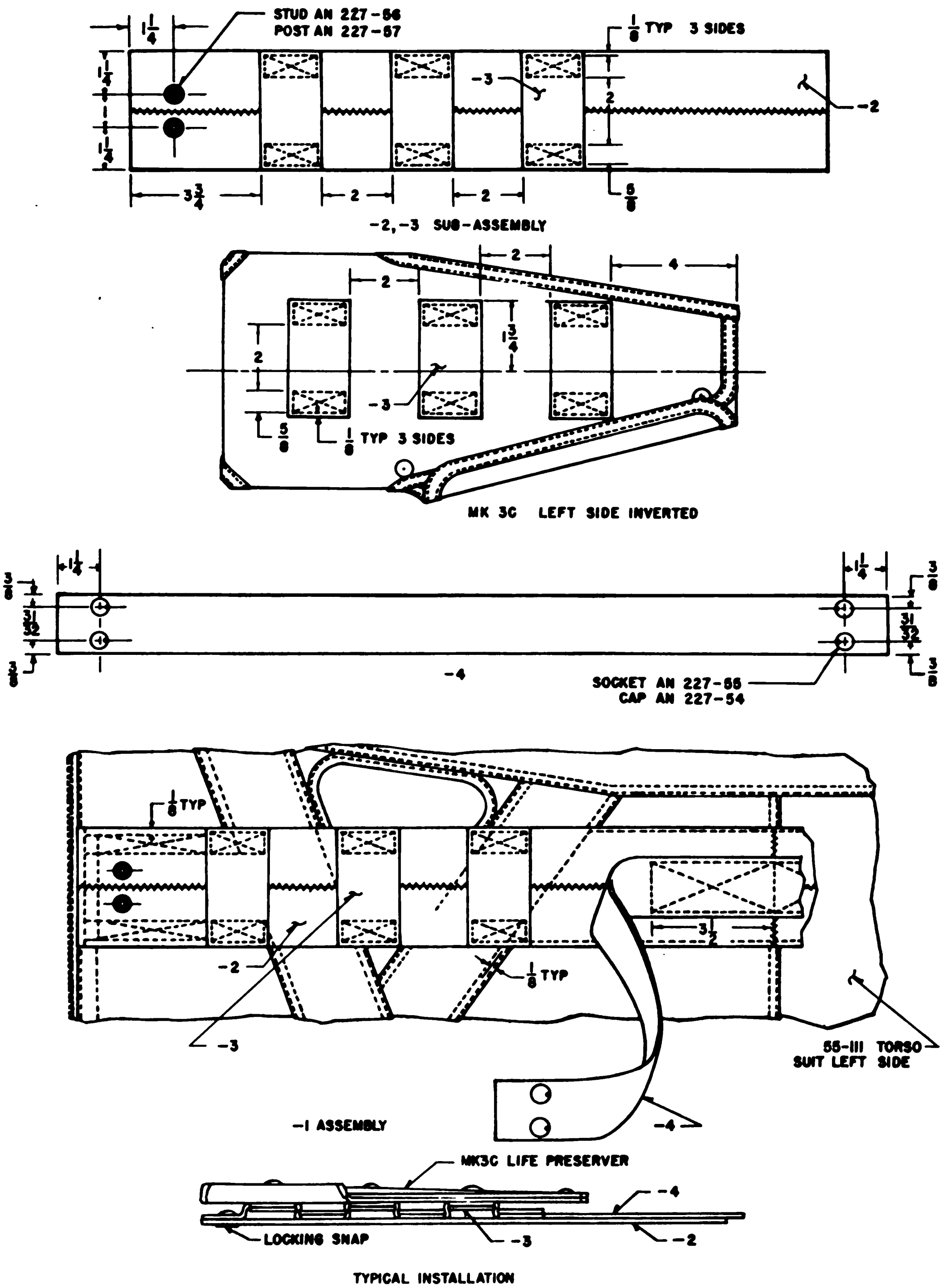


Figure 15-29. —Attaching the Mk 3C life preserver to the torso harness suit.

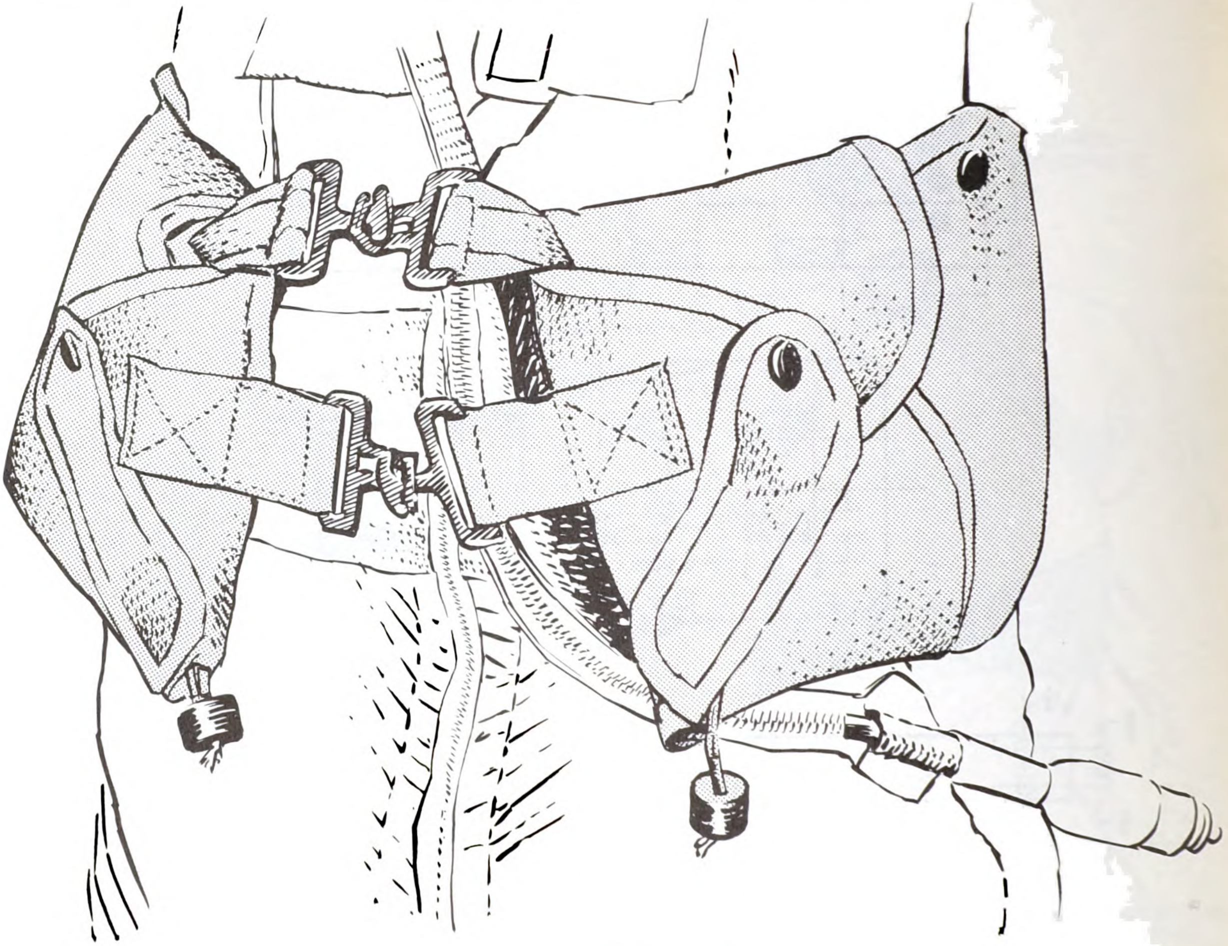


Figure 15-30. —Finished installation.

4. From one of the remaining 45-inch lengths of webbing, cut 12 pieces, each 3 1/2 inches in length. Sear ends.

5. Using size E nylon thread, stitch the 12 pieces of webbing (3) to the reinforcement webbings (2) and to the back side of the Mk 3C life preserver containers as illustrated in figure 15-29.

6. Using size E nylon thread, starting at the left-hand side of the torso suit slide fastener, stitch subassembly (2, 3) to the torso suit but do not stitch down right-hand end of (2). Starting at the right-hand side of the torso suit slide fastener, stitch the other subassembly (2, 3) to the torso suit. Butt end to end of left-hand subassembly and turn under and stitch to back center seam of torso suit. See assembly (1). The amount turned under will vary with the size of the suit.

7. Using the remaining 45-inch length of Type VI nylon webbing, fabricate the belt (4). Mark centerline of this piece (22 1/2 inches) and stitch centerline of reinforcement (2) and torso suit. Next, stitch (4) to (2) to the left and right of the back centerline a distance of approximately 7 inches (3 1/2 each side) as illustrated in assembly (1). This distance may vary with torso suit size.

8. Reinstall flare pockets and CO_2 cylinder retainer pocket in right and left Mk 3C containers, as originally installed.

Reassemble components and complete modification as follows:

1. Thread webbing (4) through alternate loops, starting with loops on Mk 3C right and left containers.

2. Reattach and repack life preserver, installing rear center section fabric cover.

3. Pull ends of belt (4) taut and make certain life preserver is evenly and correctly secured to the torso suit. Locate ends of belt (4) in relation to webbing (2) and install snaps, socket

(AN227-55), and cap (AN227-54) to mate with studs on (2) as illustrated in figure 15-29.

4. The finished installation is illustrated in figure 15-30.

INSPECTIONS

The following inspection must be conducted prior to the use of the Mk 3C life preserver. Inspect all exposed metal parts of the preserver for evidence of corrosion. If corrosion is present, report the preserver for repairs and replace with a satisfactory preserver. Examine outside of packs and harness for signs of excessive wear. Check to insure that there is nylon thread (Type A) secured to the cotter key. If the nylon thread is missing, the preserver must be set aside until the periodic inspection. Don preserver and adjust harness as necessary to insure proper fit of preserver.

The following inspection must be made of all Mk 3C preservers prior to placing in service and quarterly on all preservers in service.

1. Inspect all fabric and all webbing for evidence of chafing or fraying.
2. Inspect all metal parts for evidence of corrosion, and replace if necessary.
3. Check all equipment pockets and loops for strength of attachment.

Leakage Test

Each flotation cell of the preserver must be individually tested by inflation to 2 p.s.i. as follows: Inflate the flotation cell with air through the oral valve to a pressure of 2 p.s.i. and allow to stand for 1 hour. The pressure should then be checked and readjusted to the original pressure of 2 p.s.i., if necessary. After a minimum of 12 hours, the pressure is then measured in the cell and the pressure reading corrected for any changes in temperature or barometric pressure.

The flotation cell under test is then deflated and the same test conducted separately on the flotation cell. Any preserver showing a corrected pressure value of less than 1.50 p.s.i. in either flotation cell must be rejected as unserviceable. Pressure must be measured by means of an accurately calibrated laboratory type pressure gage.

Care should be taken when using high-pressure air lines in conducting inflation tests to insure that life preservers are not subjected to pressures in excess of 2 p.s.i. Pressures in excess of 5 p.s.i. may weaken or damage the coated fabric.

Functioning Test

The proper functiong of each preserver is determined by discharging a CO_2 cylinder into each of the flotation cells in the normal manner, by pulling the toggles. The oral inflation valves should be locked. Both flotation cells should inflate instantly.

Deflation of the flotation cell is accomplished by unlocking the oral inflation valve and allowing discharge through the oral valves. The oral inflation valves should operate without difficulty and shut off securely.

QUIZ

1. The antiexposure suit is classified as
   a. flight clothing
   b. a flight suit
   c. protective clothing
   d. tropic clothing

2. The summer flight suit may be worn over the
   a. life preserver
   b. parachute harness
   c. exposure suit
   d. anti-g suit

3. Hemming by hand is one of the most useful methods of
   a. securing a fold or hem on finished edges
   b. reinforcement
   c. making a parachute
   d. securing a nameplate

4. The double needle stitch is comparable to a machine stitch and the thread locks in the
   a. center of the plies of material
   b. top ply of material
   c. bottom ply of material
   d. none of the above

5. The direction in which a buttonhole is cut
   a. is at the discretion of the individual
   b. is vertical
   c. is horizontal
   d. depends upon the amount of strain

6. The material or materials used to make up fire retardant compound is 6 gallons of water and
   a. 2 pounds of borax
   b. 1 1/2 pounds of boric acid
   c. 1 1/2 pounds of diammonium phosphate
   d. all of the above

7. The integrated torso harness suit is available in________sizes.
   a. 3
   b. 4
   c. 12
   d. 13
8. Proper leg fit on the Z-3 anti-g suit is obtained by
   a. lacings
   b. zipper inserts
   c. using the next size
   d. adjustable webbing
9. The pressure used for testing the anti-g bladders is________p.s.i.
   a. 1
   b. 2
   c. 4
   d. 5
10. What is the purpose of the anti-g suit?
    a. Prevents pooling of the blood in the abdomen
    b. Prevents pooling of the blood in the lower extremities
    c. Forces blood from the lower to the upper part of the body
    d. All of the above
11. The g's an average pilot may withstand before losing vision or blacking out, without an anti-g suit is
    a. 1.5 to 2.5 g's
    b. 2.5 to 3.5 g's
    c. 3.5 to 4.5 g's
    d. 4.5 to 5.5 g's
12. The bladders in the anti-g suit are protected from collapsing by
    a. soapstone talc
    b. a coiled wire
    c. air pressure
    d. anti-g regulating valve
13. The Z-2 anti-g suit is available in________sizes.
    a. 4
    b. 6
    c. 9
    d. 11
14. Zipper leg inserts for the anti-g suit are available in____________widths.
    a. 1/2" and 1 1/2"
    b. 3/4" and 1 1/4"
    c. 1/4" and 1 1/4"
    d. 3/4" and 1 1/2"
15. The complete Mk4 antiexposure suit consists of an
    a. outer garment, inner liner, and gloves
    b. outer garment, inner liner, and boots
    c. anti-g suit, outer garment, and inner liner
    d. outer garment, inner liner, boots, and gloves
16. While flying at altitude, excessive pressure may be vented from the MK 4 antiexposure suit by
    a. opening the entry portal
    b. actuating a valve on the boot
    c. venting air through neck seal
    d. venting air through wrist seal
17. The quick-donning antiexposure coverall is available in
    a. 1 size
    b. 4 sizes
    c. 7 sizes
    d. 12 sizes
18. The Mk 2 life vest is manufactured of
    a. rubber impregnated vinyl
    b. neoprene coated nylon
    c. rubber coated cotton
    d. chloroprene coated nylon
19. The Mk 2 life vest actuating units are safety tied with
    a. 0.032 copper wire
    b. 0.040 copper wire
    c. 0.016 copper wire
    d. size B nylon thread
20. The Mk 3C life preserver, fully inflated, provides a minimum buoyancy of________pounds.
    a. 20
    b. 30
    c. 60
    d. 10
21. The CO_2 cylinders for the Mk 3C contain a charge of at least
    a. 8 grams
    b. 28 grams
    c. 0.28 pounds
    d. 0.50 pounds
22. The full pressure suit is a flexible pressure-tight garment intended for wear by flight personnel in aircraft with flight capabilities of altitudes above ____________feet.
    a. 35,000
    b. 40,000
    c. 50,000
    d. 60,000
23. A piece of accessory suit equipment would be
    a. gloves
    b. boots
    c. integrated flotation garment
    d. helmet
24. The full pressure suit will immediately become pressurized
    a. when ambient absolute pressure falls below 3.4 p.s.i.
    b. when ambient absolute pressure falls below 4.3 p.s.i.
    c. during extremely cold temperatures
    d. at all altitudes

CHAPTER 16

STANDARD LIFE RAFTS AND EQUIPMENT

Every naval aircraft making an operational flight over water is required to carry appropriate life rafts. The size of the raft or rafts applicable to a particular aircraft is determined by the number in the crew and the passenger accommodations. It is the responsibility of the Parachute Rigger to inspect, install, and maintain the various types of rafts and the equipment provided with them.

MULTIPLACE LIFE RAFTS

All multiplace life rafts are of the same construction but vary in size and in the quantity of equipment they carry. As a safety measure they have separate air compartments, so that in case one compartment is punctured, the raft will still maintain its buoyancy. In the Mk 4 for example, there are three air compartments—two automatically inflated compartments, and a seat compartment which can be inflated with a hand pump. The two automatically inflated compartments are separated by a vertical bulkhead amidship.

Life rafts are made of rubber-coated cotton material. This material is easily punctured; therefore, care must be taken to avoid contact with sharp objects. Even the oars can puncture the material if they are used carelessly.

Each raft is enclosed in a carrying case secured with snap fasteners. As the raft inflates, the snap fasteners are forced apart and the inflated raft emerges from the case. The case may be used as an additional drogue or sea anchor.

Multiplace rafts may be dropped to survivors of sea accidents, or carried in multiplace aircraft for use in event of ditching or other emergencies at sea.

Construction

The body of the raft consists of an encircling buoyant tube and a fabric bottom. The fabric used in the construction of the rafts is type O. To provide the specified shape, not less than six sections are used in the bow, and not less than five sections in the stern. The fabric bottom of the raft is applied without tension across the enclosure formed by the flotation tube and is attached securely to the underside, extending four inches beyond the centerline, all around the tube. Along this attaching line, different widths of tape are applied for reinforcing and finishing-off purposes.

The components listed in the following paragraphs are in accordance with standard drawings applicable to each size. Figure 16-1 shows the major components of a multiplace life raft assembly.

SEAMS

All seams and attachments are secured by self-curing rubber cement or by vulcanization. No stitches are used in the seams or through the fabric of any compartment. However, sewing is permitted in the construction of patches, oarlocks, discs, flap seats, cylinder carriers, lifeline supports, handles, and pockets.

The minimum overlap for seams is three-fourths of an inch. They are reinforced both on the inside and on the outside with type R tape. The tape is applied in such a way that an equal amount of width is on each side of the seam edge which it covers. The cement is applied in a straight line, parallel to the edges of the tape, and extends approximately one-eighth inch beyond the tape edges.

BULKHEADS

The flotation tube is separated into two compartments by internal vertical bulkheads. Bulkheads are constructed of type N rubberized fabric and are either hemispherical or conical in design. The bulkheads are installed amidships, equidistant from the bow and stern, in such a way that the volume of the two compartments is equal. The bulkhead-to-tube attachment is reinforced on one side with type R tape,

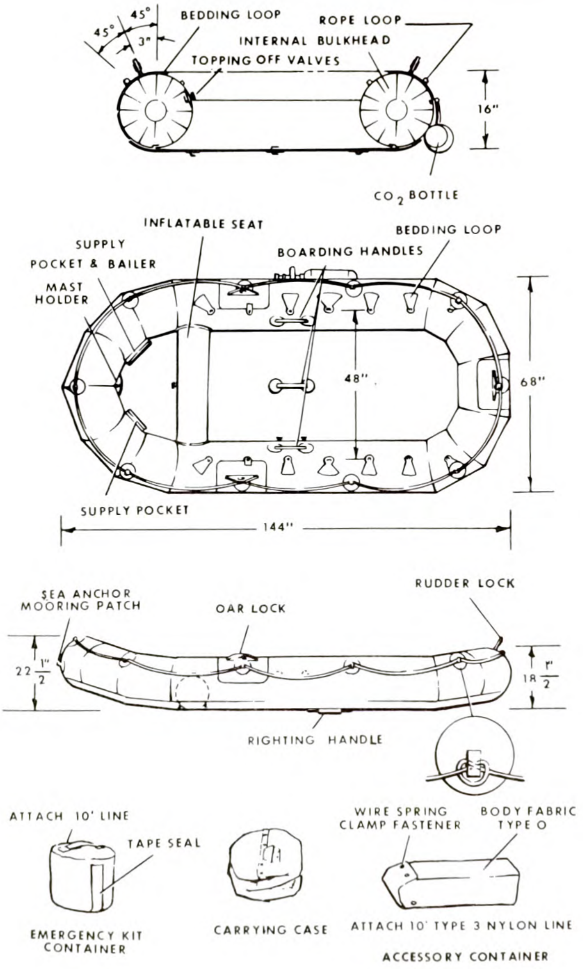


Figure 16-1.—Pneumatic multiplace life raft Mk 7.

and on the other side with a hinge of wider type N tape. A 4-inch diameter patch of type O fabric is installed on the bulkhead for protection against abrasion by the manifold diffusers when the raft is packed in the carrying case.

INFLATABLE SEATS

An inflatable seat is installed in each Mk 4 and Mk 7 life raft. These seats are circular in shape and are constructed of type O fabric. The ends of the seat are tailored to fit the curvature of the flotation tube. Each end of the seat is blocked with type N fabric, making the seat an independent air chamber before it is installed. These seats are independently inflated by a valve, using the hand pump provided.

The seat is attached to the bottom of the raft with a hinge tape of type N fabric, extending the length of the seat tube. This method of attachment allows for expansion, and prevents undue stresses between the bottom of the raft and the seat.

OARLOCKS

The oarlock consists of seven plies of type O fabric cemented together. The two outside plies on each side are folded outward at right angles to form a base. The fold of the outer plies, which forms the top of the base, is not less than 1 1/2 inches wide; whereas the fold of the inner plies, which forms the bottom of the base, is not less than 1 inch wide. The outside edge of the oarlock is taped with type R tape to make a smooth surface. A patch of type O fabric of sufficient size to extend 1 inch beyond each end of the oarlock base, and containing a slot through which the upright section of the oarlock passes, can be sewed or cemented securely to the flotation tube. This patch, which supports the oarlock, extends 6 inches beyond the base, and protects the flotation tube from the chafing action of the oars.

A reinforcing disc of type O fabric is sewed or cemented to the patch at each end of its slot. A No. 11 brass grommet is set in each oarlock, located so that the bottom edge of the hole is 1 inch above the flotation tube. Each oarlock is attached to the flotation tube outside the top centerline in such a position that the upright portion, containing the grommet, is at an angle from the vertical, inclined away from the centerline. An oarlock is also attached to the top of the flotation tube at the stern so that an oar can be inserted through the oarlock and be used as a rudder.

MAST HOLDER

One mast holder consisting of an upper and lower structure is constructed in each raft. The upper part of the mast holder consists of an oarlock attached in a horizontal position approximately 3 inches above the inside centerline of the flotation tube. The lower part consists of a 4-inch long socket made of two plies of type O fabric. The socket is cemented to a 4-inch diameter patch consisting of two plies of type O fabric. The patch is then cemented to the raft bottom directly in line with the hole contained in the upper part. Together, these mast holder parts can support an oar handle in the vertical position. The handle passing through the upper hole in the oarlock terminates in the socket.

SUPPLY POCKET

Each raft has a supply pocket which is made from type O fabric. The pocket measures approximately 8 x 8 x 2 inches. Two large curtain type fasteners (lift-the-dot) are used to close the pocket. A piece of type R tape, 1 5/8 inches wide, is used for sealing the pocket after the contents have been placed inside. The pocket is attached to the flotation tube surface inside the raft by stitching the pocket to a patch and cementing the patch to the tube. Each pocket should be clearly and indelibly marked in 1/2-inch letters, SUPPLY POCKET.

SUPPLY POCKET AND BAILER

Another type of supply pocket is attached to each life raft. This pocket measures 10 x 10 x 2 inches and is constructed from type O fabric. The pocket is closed by means of a slide fastener across the top, which is sealed with tape after the equipment is packed. A loop of semihard spring wire is contained in the seam around the slide fastener so the pocket may be fashioned into a bailing container.

The pocket is secured to the flotation tube by means of two large curtain type fasteners so that it may be detached. To avoid loss of the pocket, it is secured to the lifeline by a 5-foot length of type III suspension nylon line. The words SUPPLIES AND BAILER are stenciled in 1/2-inch letters on the pocket. Below this, stenciled in 1/4-inch letters, are the words KNIFE, SIGNALING MIRROR, WHISTLE, LINE, COMPASS, and MAST CLAMP.

CYLINDER CARRIER

One cylinder carrier, suitable for holding the CO_2 cylinder securely in position, is provided with each life raft. The carriers are constructed and located in accordance with applicable standard drawings for each particular raft.

ACCESSORY CONTAINER

The accessory container is constructed of type O fabric. The oars and hand pump are among the items included and stowed in the accessory container. The container is protected at each end by a wad of felt or cheesecloth approximately 3/4 inch thick. This padding protects the equipment from damage when dropping the raft from aircraft. The hammock beds and paulin can be utilized to protect the other items stowed in the container. The following words are stenciled in 1/2-inch letters on the body of the container: OARS, PAULIN, PUMP, HAMMOCK BED, CORNER REFLECTOR SMOKE SIGNALS, DYE MARKERS, SPONGES.

LIFELINE

A nylon lifeline encircles the perimeter of the life raft. The line is attached to the raft by means of lifeline loops or supports. The lifeline is secured to the supports with overhand knots to prevent the line from running free through the supports. A 4-inch slack in the line is allowed between the supports.

The supports are constructed of type II, 1-inch wide, nylon tape. A strip of webbing 5 inches long is threaded through a slot in a 3-inch diameter type O fabric disc to form a loop 1 inch long. The loose ends are securely stitched to the disc and two rows of stitching are made through the base of the webbing loop. This assembly is then cemented to the top outside quarter of the flotation tube midway between the horizontal and vertical centerlines of the tube. A type O fabric disc, 5 1/2 inches in diameter, with a slot in the center is then cemented over the loop assembly to the flotation tube. Each completed lifeline patch can withstand a 200-pound pull exerted in a direction perpendicular to the base of the patch.

RIGHTING HANDLES

Each raft has three righting handles. Each handle is constructed of an 11-inch length of type II, 3/4-inch type O fabric. The handle is covered by an outer patch of type O fabric extending beyond the edge of the disc and securely cemented to the life raft. A 1-inch slack is allowed in the attachment to make them easier to grasp.

BOARDING HANDLES

Each raft has three boarding handles. These boarding handles are constructed in the same manner as the righting handles. They are attached to the life raft in accordance with the applicable drawings.

TOPPING-OFF VALVES

A topping-off valve is installed in each flotation tube compartment of the raft. The topping-off valve is used for hand inflation urposes in conjunction with the hand pump. t also serves as a means for relieving high nternal tube pressures that may possibly build p during hot sunny days. Both valves are installed on the same side of the raft, on the top nside quarter midway between the vertical and orizontal centerline 4 inches from the vertical (internal) bulkhead. When installed, the valves re covered completely by a type O fabric flap.

Stenciled instructions relative to topping-off nd deflation of the raft are applied on the raft lotation tube adjacent to the topping-off valves. ppearing in 1/4-inch block letters, the instructions are stenciled on a white rubber patch s follows:

TO INCREASE PRESSURE: Attach Hand ump to Valve. Loosen Valve 2 Turns, Then nflate Raft. When Desired Pressure Is Reached, ighten Valve Cap and Remove Pump.

TO DECREASE PRESSURE: Open Valve and leed Air.

NFLATION SYSTEM

The valve of the CO_2 cylinder is threaded nto the exterior fitting of the manifold. Since ultiplace life rafts are constructed with internal bulkheads, the purpose of the manifold is o provide a common means of directing and iffusing the flow of gas from the actuated ylinder to each of the separate compartments t the same time. To do this the manifold outlets ust bridge the internal bulkhead over which hey are mounted. Figure 16-2 illustrates the peration of a life raft inflation system.

All the exposed metal surfaces of the inflation system which might chafe the life raft abric while in a packed condition should be uitably and securely covered with cheesecloth r suitable scrap cloth.

Equipment

The equipment used in multiplace life rafts s furnished by two main sources. Some items re furnished by the contractor, while others re government furnished. The task of and esponsibility for outfitting the rafts are divided nto three phases; namely, contractor furnished nd installed equipment, government furnished nd contractor installed equipment, and government furnished and government installed quipment.

Information concerning the equipment furnished by the government (Navy) is published in applicable *Aviation Clothing and Survival Equipment Bulletins* and other related publications available in all parachute lofts. Government furnished equipment (GFE) is assigned a stock number and listed in the Navy Stock List of Aviation Supply Office under the applicable class of material. Most of the furnishings installed in life rafts during the manufacturing period are supplied by the government, leaving only the items incident to the rigging and basic operation of the raft in the hands of the contractor. A review of the equipment which is furnished under the three classification headings as outlined in the specifications will define more clearly the category and initial treatment of the equipment installed in life rafts. Figure 16-3 shows the EMERGENCY EQUIPMENT for the Mk 4 life raft, and figure 16-4 shows the ACCESSORY EQUIPMENT.

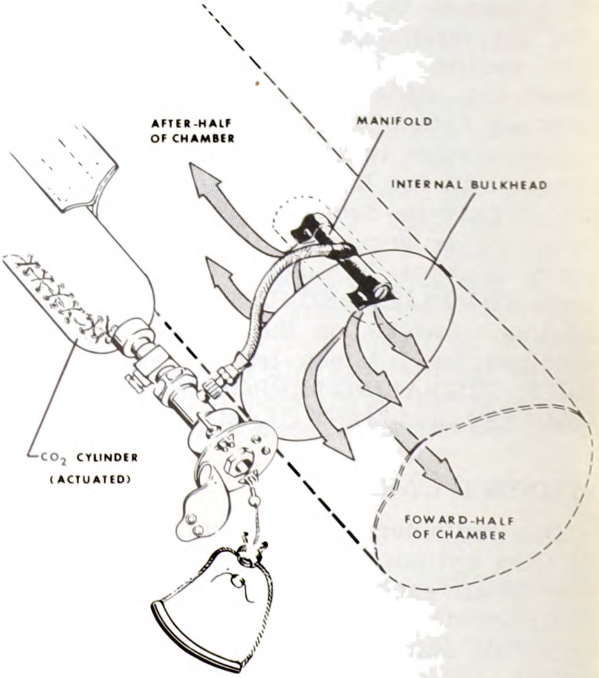


Figure 16-2.—Multiplace life raft inflation system.

CONTRACTOR FURNISHED AND INSTALLED EQUIPMENT

Oars

Three complete oars and one additional oar section are supplied with each raft. These oars have a threefold purpose. They may be used for rowing or paddling, as reflecting blades for

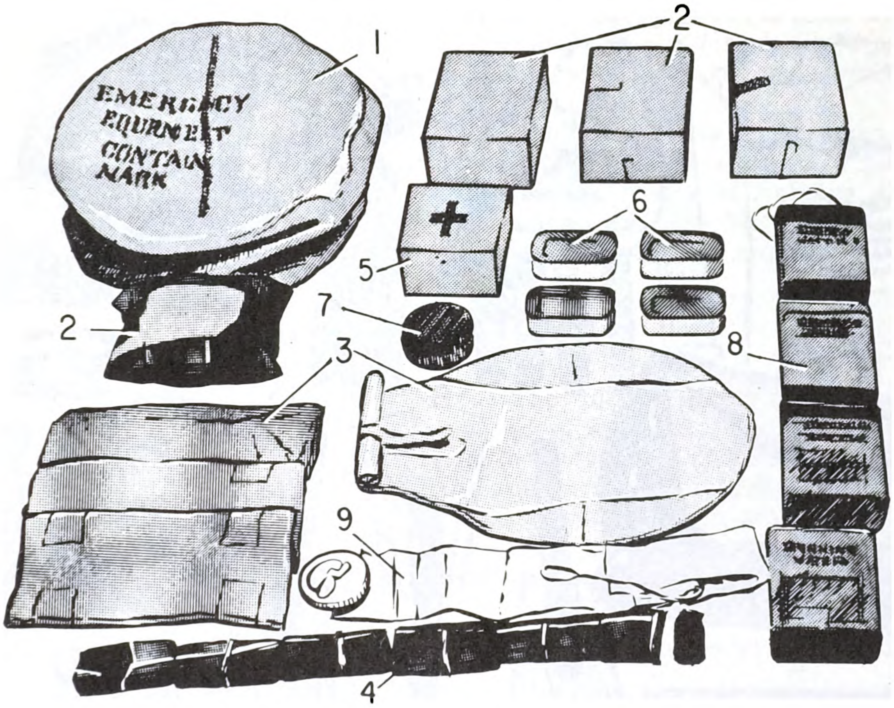


Figure 16-3.—Mk 4 life raft emergency equipment.

1. Equipment container.
2. Solar stills.
3. Water stowage bags.
4. Salt removing chemicals.
5. First aid kit.
6. Emergency rations.
7. Sunburn ointment.
8. Desalting kits.
9. Desalting bag.

identification purposes in night rescue, and in varying combinations of length as a mast for rigging a shelter or in mounting a radar reflector.

The oars for the Mk 7 rafts are 6 feet long; whereas, the oars for smaller size rafts are 5 feet long. All sectional oars are made of three sections each (A, B, and C) as shown in figure 16-5. The oars are constructed from aluminum alloy and the paddle blade is coated with a retroreflective material for night reflecting purposes. Oars are stored in the accessories containers of the respective rafts.

Hand Inflation Pump

Pumps are provided with all multiplace life rafts and are used to inflate the rafts in case of failure of the CO_2 inflation system. The pump is also used to "top off" the raft after initial inflation with CO_2.

Hand pumps are stowed in the accessories container and held secure by a 3-foot length of type I nylon line.

Nylon Cord

For utility purposes, 100 feet of type I nylon line is supplied with each life raft. It is kept in the supply pocket of the raft.

Whistle

A whistle (police type) is provided for all rafts and is stowed in the supply pocket. The whistle is to be used by personnel for attracting attention of a rescue ship or personnel in foggy weather, or at night. In still air and perfect silence, the whistle may be heard for 1,000 yards. Many successful rescues have been due to the use of a whistle. For security purposes, the whistle is attached to a 3-foot line.

Bailing Sponge

Bailing sponges are provided for all life rafts. The bailing sponge is of the common cellulose variety and is provided in varying quantities for the different size rafts. The sponge is used for bailing water collected in the bottom of

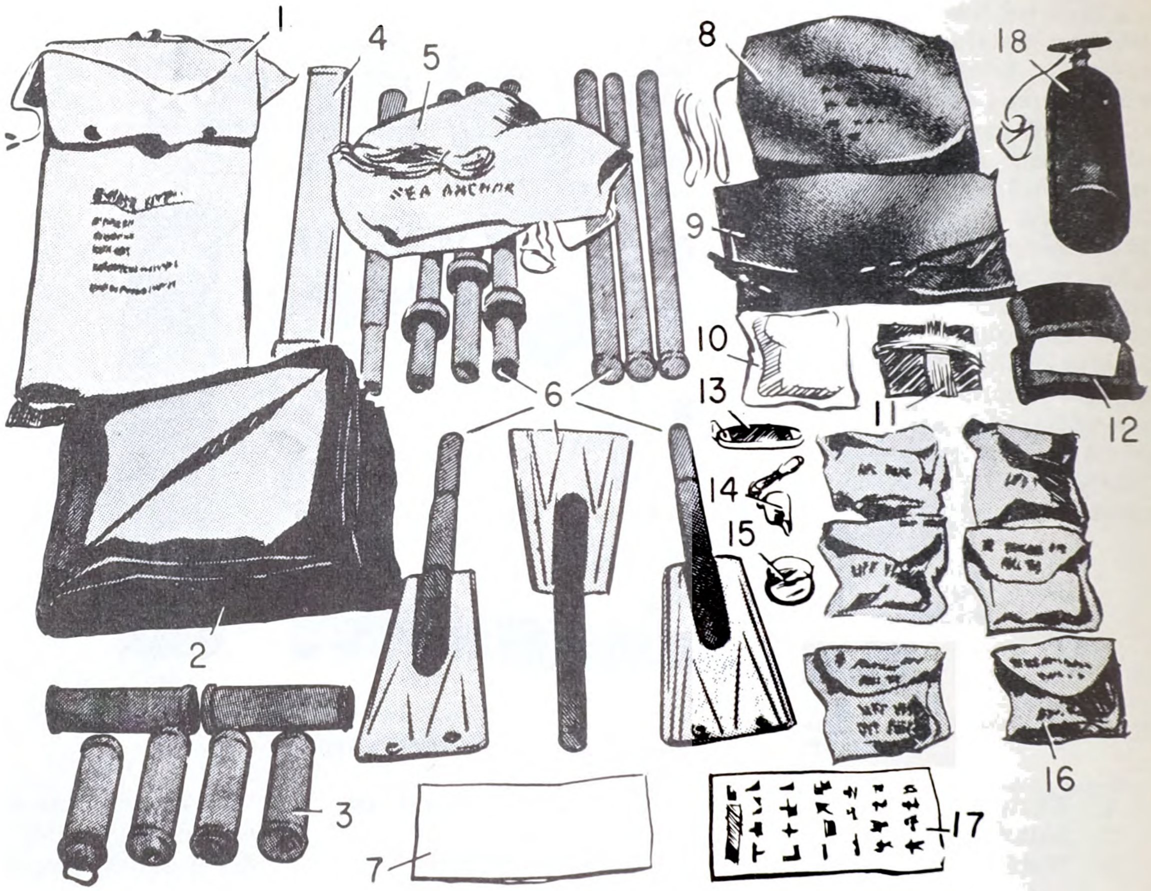


Figure 16-4.—Mk 4 life raft accessory equipment.

1. Accessory container.
2. Paulin.
3. Smoke signals.
4. Corner reflector.
5. Sea anchor.
6. Oars.
7. Ground air emergency code.
8. Bailer.
9. Hammock.
10. Signaling mirror.
11. Line.
12. Sponge.
13. Knife.
14. Whistle.
15. Compass.
16. Dye marker.
17. Paulin signals.
18. Hand pump.

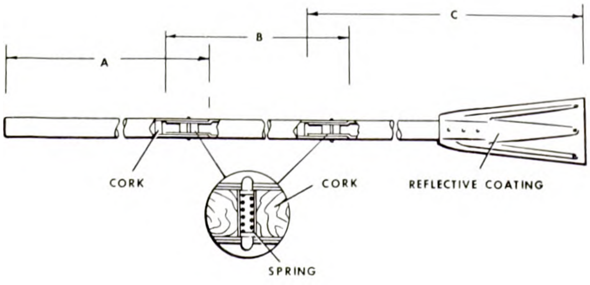


Figure 16-5.—Pneumatic life raft sectional oar.

the raft, and may also be used for collecting rainwater for drinking purposes.

Life Raft Carrying Case

Life rafts are packed in carrying cases constructed of orange-yellow-coated fabric corresponding to the color of the rafts. The carrying case is designed to hold the raft in a deflated but ready condition for inflation wherever it is stowed. The closing hems of the case are fitted with snap fasteners, capable of being released in any direction of pull. The tenacity with which these snaps hold the raft in its case must not be too great. The pressures exerted by an inflating raft must be sufficient to "pop open" the snaps and release the raft without harm.

Retaining Line

The purpose of the retaining line is to secure the raft to one of the users, thus preventing its loss before and after the raft is inflated. It consists of a 10-foot length of 1-inch webbing and is orange yellow in color. One end is secured to the neck of the CO_2 cylinder while the other end has a snap which can be attached to the life vest retaining loop of the user. Attached to the snaphook is an instruction tag (3-1/2 x 5 inches) of type O fabric. The tag is imprinted with 1/2-inch letters, and reads: BEFORE INFLATION, CLIP SNAPHOOK TO LIFE VEST. When the raft is packed in its carrying case, the retainer is accordion folded and held in place inside with breakable nylon thread or synthetic elastic bands. The free end of the retainer, with the snaphook and instructions, is rigged to emerge from the carrying case adjacent to the CO_2 inflation handle for quick attachment to the user.

Sea Anchor

The sea anchor furnished is a circular cone-shaped fabric device with an open bottom. The sea anchor is packed so that it falls into the water as soon as the raft is inflated. This reduces the danger of capsizing the raft by checking the drift and holding it "bow on" into a heavy sea. By reducing wind drift and slowing the raft down, the sea anchor also makes it easier for a man in the water to catch the raft. The sea anchor is also important in case of a helicopter pickup, for it helps keep the raft from drifting in the downdraft created by the helicopter rotors.

By virtue of the nature of its use, a sea anchor must be securely rigged to a strong mooring purchase. Such a mooring purchase is devised in a patch which, when cemented to the raft, is capable of withstanding a perpendicular pull of 400 pounds. Once the raft is inflated, a strong keeper line, which is longer than the one originally attached, should be secured between the raft and the sea anchor. In making the additional purchase, it should not be secured to the same mooring patch.

Hammock Bed

The raft hammock is suspended between the flotation tubes. The taut canvas provides a means of keeping off the floor when weather and sea conditions are adverse. The hammock may also be used to protect survivors from wind and rain.

The hammock is constructed of water repellent fabric, and is secured to the raft by wooden toggles and loops of webbing. One hammock is furnished with the Mk 4 and two with the Mk 7. The hammock is stowed in the accessory container.

Mast Clamp

The mast clamp is used primarily as an aid in rigging a sail. In lieu of the mast clamp, nylon cord can be used in securing a cross-member of an oar, serving as a mast. The clamp and line can also be used in securing a distress signal to an oar. The mast clamp is stowed in the raft supply pocket.

Emergency Equipment Container

The emergency equipment container is drum-like in shape. The container has a slide fastener closure installed in one end for admittance of the equipment. Since multiplace rafts vary in size, the container sizes also vary to accommodate more equipment needed for the larger rafts.

Each container is stenciled in 1-inch letters with the Mk number corresponding to the Mk number of the life raft. A strip of type R tape accompanies each container. It is used for sealing the slide fastener after the container has been equipped. For shipment by the manufacturer, the empty container is secured to the raft by fastening the snap of the container line to the lifeline of the raft near the CO_2 cylinder.

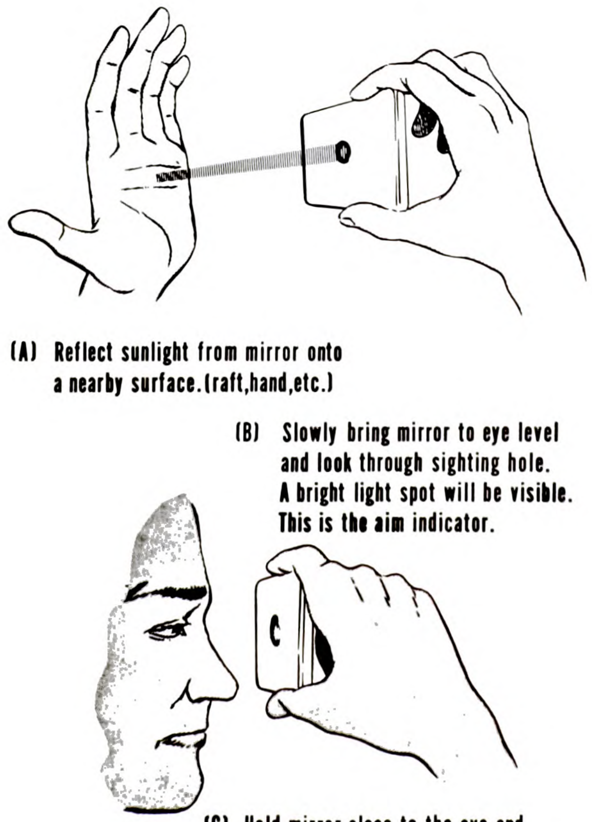
GOVERNMENT FURNISHED AND CONTRACTOR INSTALLED EQUIPMENT

Signaling Mirror

The emergency signaling mirror consists of a metallic reflecting plate and a sighting device. It is used by personnel in life rafts or on land to attract attention of passing aircraft or ships by reflection either in sunlight or in hazy weather. The reflections of this shatterproof mirror can be seen at a distance 3 to 5 times as great as those which a life raft can be sighted at sea. On a clear sunny day, the mirror will reflect the equivalent of 8 million candlepower. Flashes from the mirror have been seen from a distance of 40 miles.

The mirror is approximately 3 x 5 inches. For protection of the highly polished surface of the mirror, it is placed in a plastic pouch which is fitted with a nylon lanyard and a flap type closure, secured with a button. Each raft is supplied with one mirror which is stowed in the supply pocket.

Figure 16-6 illustrates the operation of the signaling mirror. Past experience indicates that personnel may have difficulty using the mirror in a bobbling raft at sea. Practice signaling with the mirror on the ground should be encouraged as part of the training program for flight crews. Such practice will reduce the difficulty in case of emergencies. Before using the mirror, the protective coating must be removed from its surface.


(A) Reflect sunlight from mirror onto a nearby surface.(raft,hand,etc.)

(B) Slowly bring mirror to eye level and look through sighting hole. A bright light spot will be visible. This is the aim indicator.

(C) Hold mirror close to the eye and slowly turn and manipulate it so that the bright light spot is on the target.

Figure 16-6.—Operation of the signaling mirror.

Jackknife

The jackknife is a scout type, consisting of one large blade, a combination screwdriver and bottle opener and one can opener. It is furnished with a 3-foot lanyard. One jackknife is furnished with each life raft and stowed in the supply pocket. The value of a jackknife, especially under emergency circumstances, need not be emphasized as everyone can visualize its usefulness. When in a raft, one should never let the opened knife dangle from its lanyard nor lay on the bottom of the raft.

Pocket Compass

The magnetic card type compass is encased in a cylindrical transparent plastic cover with a reference line inscribed on top of the case. A circular card swings on a jeweled bearing, while a centered pivot supports and suspends the card in its free movement.

To cage the compass and protect the jeweled bearing, it is stored in an inverted position. The compass is reasonably shockproof, but it should be handled with care if one is to expect reliable readings. Damage to the case will impair its waterproof qualities, and promote corrosion in spite of its internal corrosion-resistant construction. Fittings outside of the base adapt the compass for wrist wear. One compass is provided for each life raft and is stowed in the supply pocket.

Corner Reflector

The corner reflector shown in figure 16-7 is to be used on life rafts to increase the range of radar detection. The reflector has the property of reflecting back to the source a large portion of the radar energy that strikes it.

The corner reflector, also known as a "target" reflector is an umbrella-like antenna made of eight triangular planes of Monel metal mesh that intersect each other at right angles. The effective range of the reflector is from 2 to 18 miles.

One MX-138A corner reflector is stowed in the accessory container. The sealed carton containing the reflector is not to be opened except for actual emergency use. Each carton is provided with a short lanyard for securing it to the accessory container, which, in turn, is secured to the life raft.

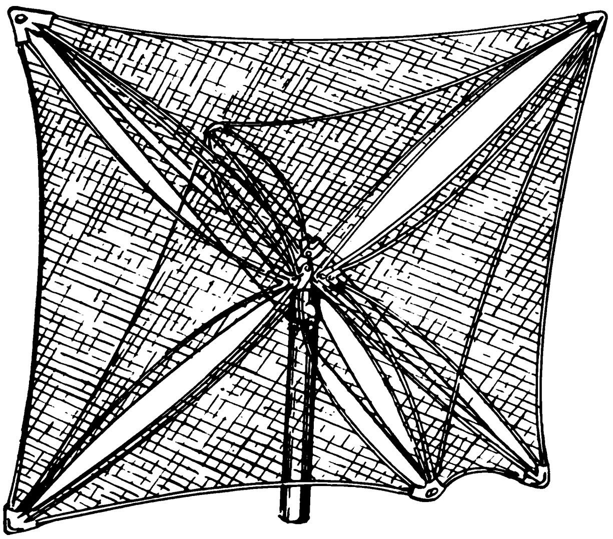


Figure 16-7.—Corner reflector.

Although corner reflectors are manufactured according to specifications, certain minor variations (latitude in manufacture) in the details of construction, which do not materially affect their operating characteristics, are permitted. Realizing this, the following steps are given as a general guide and are not to be considered as being inflexible rules. They are presented to familiarize the Parachute Rigger with the general erecting procedures for the MX-138A and/or the MX-138A/A corner reflectors.

1. After removing from carton, tie end of securing line to raft and remove taped paper collars from each end of reflector.
2. Unwind the steel stay cable having an unfastened hook at its end.
3. Unwrap wire mesh carefully from around metal arms. Shake reflector gently and pull outward slightly on each arm to free mesh planes.
4. With hub toward you, graps the two arms, having red painted ends, near the hub and pull down until they are at right angles to the hub; at the same time, pull on the arm, to which the stay cable will be attached (instruction tag is tied to this arm), until it is also at right angles to the hub.
5. Holding the three arms at right angles (near as possible to right angles), brace end of arm to which tie cable is attached against toe of shoe and flip reflector open.

NOTE: Since the planes must be stretched rigidly in order to function properly, one or two of the aluminum arms might tend to bow under the tension as the reflector is brought to its full open position. The bowed condition of the arms will not affect the function of the planes. However, a kink in any one of the tube arms can weaken the tension on the planes and cause a sagging condition.

6. Insert hook on stay cable in eyelet on opposite arm to hold reflector open and under tension.
7. Connect two sections of oar handle to form mast and slip end through loop in stay cable. Mount reflector on mast, making certain that it is secured firmly.
8. Force rubber oar collar over free end of mast, working it along a short distance. Slip end of mast through mast holder on raft, as shown in figure 16-8.

With end of mast through the raft holder, force on a second rubber collar. Slide it up and out of the way. Slip end of mast in cup on raft bottom. Now, adjust the two rubber collars, one on top of the holder and the other on the bottom, so that the mast is forced down against the bottom of the raft.

9. The mast places the reflector at a proper height for air search, but when a surface vessel is sighted add all extra sections of oar handle to mast and hold reflector as high as possible. DO NOT WAVE REFLECTOR.

CAUTION: The effectiveness of a corner reflector depends on the accuracy of its right-angled corner. Do not tear, warp, or distort its planes.

Water Storage Bags

The water storage bags are made of strong transparent pliable plastic and will hold 5 quarts of water. The open end is reinforced and is designed to hold itself in a closed position. To seal the bag, use must be made of the strap and buckle located near its end. The bag can be sealed tightly by rolling or folding its opening for a short distance, and by securing the folds with the strap and buckle. The water storage bag is shown in the closed position in figure 16-3.

When the bag is not being used for holding water, it can be used for stowage of items in need of protection from salt water. Protecting articles in this manner can lead to contamination; therefore, articles should be wrapped in something to prevent lubricants and other contaminants from coming in direct contact with the interior of the bag. Water storage bags can also be inflated, coupled with one another, and used as water wings for swimming. Water storage bags are stowed in the equipment containers of life rafts; four in the Mk 4 and seven in the Mk 7.

Dye Markers

The dye marker packet contains a small quantity of crystalline dye compound. When the compound is exposed to the water, it slowly dissolves while producing a brilliant yellowish-green fluorescence. Under good conditions the dye is exhausted in 20 to 30 minutes and ceases to be a good target after an hour. The dye is visible at an approximate distance of 10 miles at 3,000 feet altitude.

An exterior orange-yellow envelope serves the purposes of: (1) providing a waterproof container for the dye compound in a loosely woven bag; (2) acting as an anchoring point for the dye pouch which is secured to a long tape; and (3) supporting a tape across the top of the envelope which is used to tie the marker to life

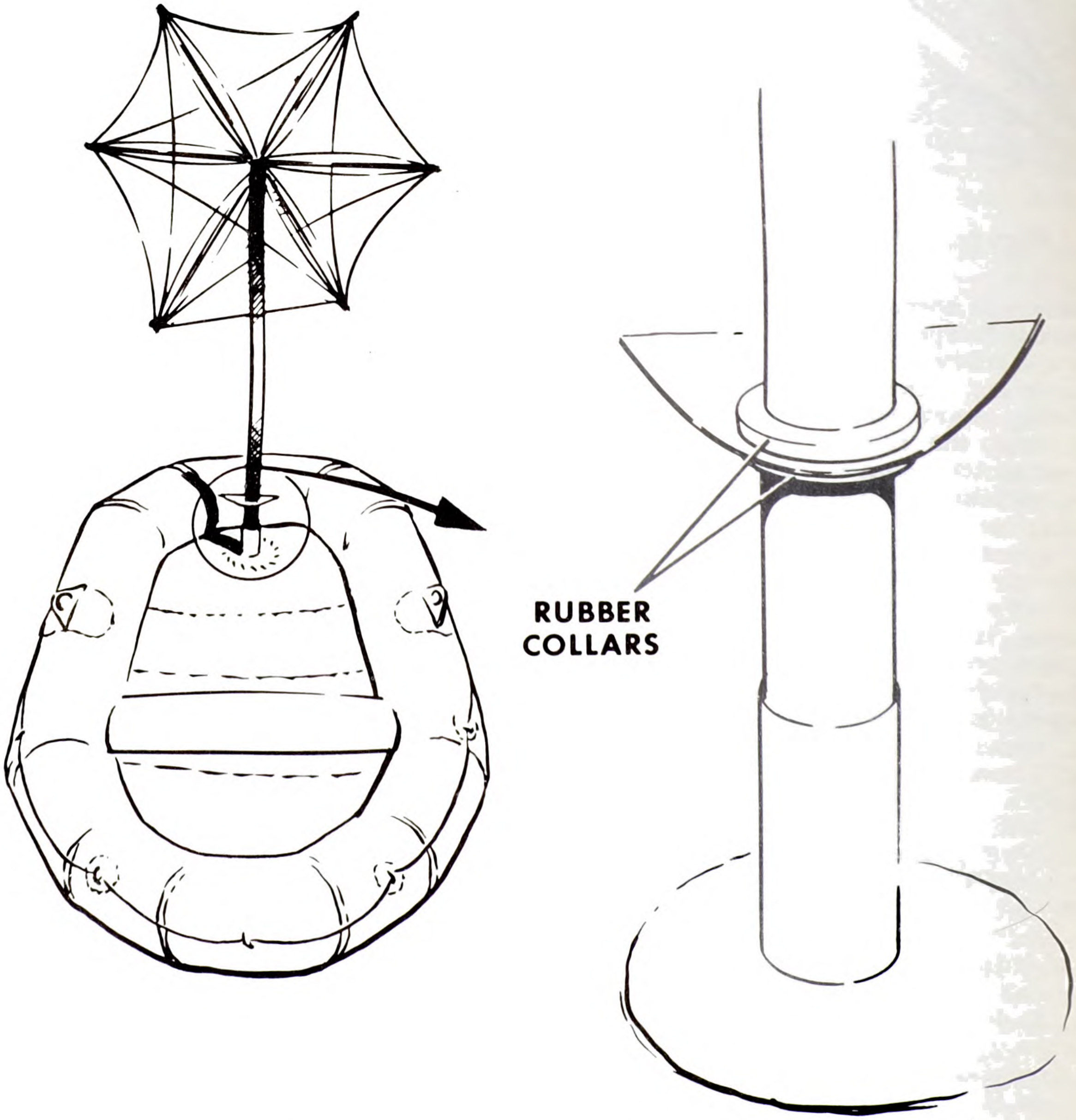


Figure 16-8.—Method of securing mast of corner reflector to life raft.

vests and other basic items of survival. The accessories container of each size life raft is supplied with six dye markers. Figure 16-9 shows the exterior and interior views of the dye marker.

Emergency Signaling Code

The GROUND/AIR EMERGENCY CODE was designed to establish an international means of communication by the use of symbols between survivors and search and rescue parties. Its instructions and illustrations, printed on tough water-resistant paper, outline a series of conditions relative to emergencies in connection with disabled aircraft, medical problems, landing instructions for the rescuing party, etc. Strips of cloth, sticks, stones, or anything available may be used to create the symbols.

The importance of the code is illustrated by the number of survival items which are equipped with it. One copy of the code is inserted in the inspection date pockets of all parachutes. The chest type parachute loses its pack upon opening; therefore, the parachute is specially equipped with a code pocket located on the yoke of its lift web assembly. Every life raft is supplied with one of these codes which is stowed in the supply pocket. A copy of the code must also be made available for navigation chart boards, and in places where chart boards are not used. The code may also be posted in the flight compartment of aircraft.

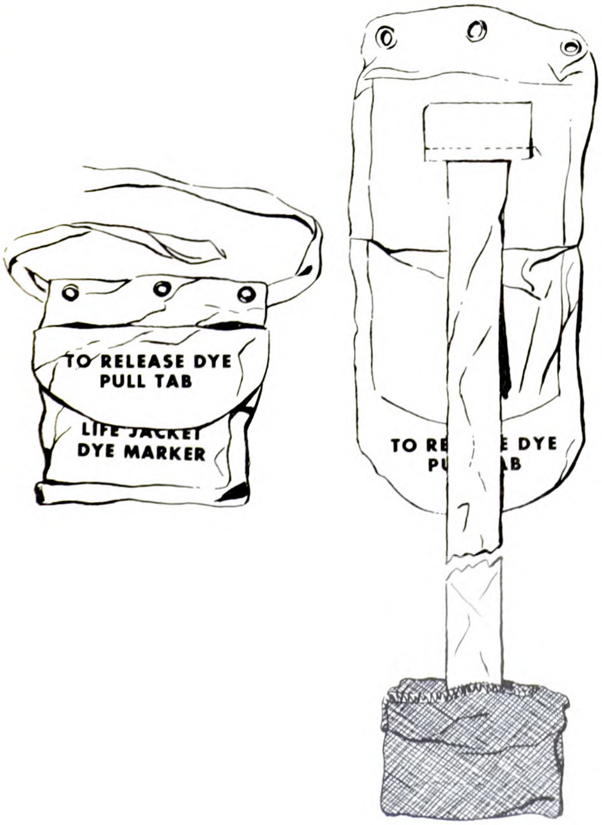


Figure 16-9.—The dye marker

Desalting Kit

The desalting kit is used by personnel aboard life rafts for making fresh water from salt water. Each package of chemical (briquets), when mixed with sea water in the plastic bag, makes about one pint of drinkable water. Before the chemical kits were made available, fresh water was contained in pint-sized cans. The cans of water posed many problems. They were cumbersome, weighty, became undrinkable with age, and invited rust. Although the kits represent a great advancement, their potential is limited to the number of briquets that are packed in them.

The desalting kit consists of a hinged metal container with a retaining lanyard, seven or eight wrapped desalting briquets, a length of mending tape, and a plastic bag for processing the water to be desalted. The briquets, processing bag, and mending tape are attached to a nylon tie tape, to each other, and to the metal container, as shown in figure 16-10. The desalting kits are stowed in the emergency equipment container. Four kits are furnished for the Mk 4 raft and seven for the Mk 7.

The vinylite bag should be rinsed to decrease the taste which passes into the treated water. This is done by filling the bag one-third full of sea water and rubbing the inner surfaces of the bag gently for 2 minutes and then rinsing several times with fresh sea water.

The chemical process is purposely adjusted to leave a little salt in the desalted water to compensate for perspiration losses. If a less salty taste is desired, a smaller amount of water can be used in the bag.

The procedure for using the desalting kit follows:

1. Screw plug into outlet tube at the bottom and fill bag to line with sea water.
2. Take out one package of chemical and close container.
3. Remove outer wrapping of briquet, tear off one end of transparent inner wrapping, and pour all of the chemical into the bag of sea water.

4. Fold the top of the bag down tightly, lling it towards the buckle and strap to make watertight seal.

5. Permit the chemical to stand in the bag a few minutes, and it will disintegrate.

6. Further pulverize the chemical by knead-g it gently for 15 minutes.

7. Shake the bag gently for 30 minutes.

8. To drink the water, unscrew the plug from e tube located at the bottom of the bag, being reful not to squeeze the bag. Put the tube in the outh, and gently squeeze the bag or suck on e tube. Spit out the first few drops if too salty.

9. When finished drinking, replace screw-ug. The remaining water can be left stowed in e bag.

10. When all the water has been drawn from the bag, rinse out the chemical with sea water. The bag is then ready for reuse.

11. In case the bag becomes damaged, dry the affected area carefully and apply a patch of the mending tape provided.

If the plastic bag becomes damaged beyond repair or is lost, the metal container can be used. In this case, fill the container to the line marked on the inside. Then add one package of the chemical and shake the can gently for 30 minutes. Drink the water through an emergency filter, made by holding a piece of cloth over the top of the can.

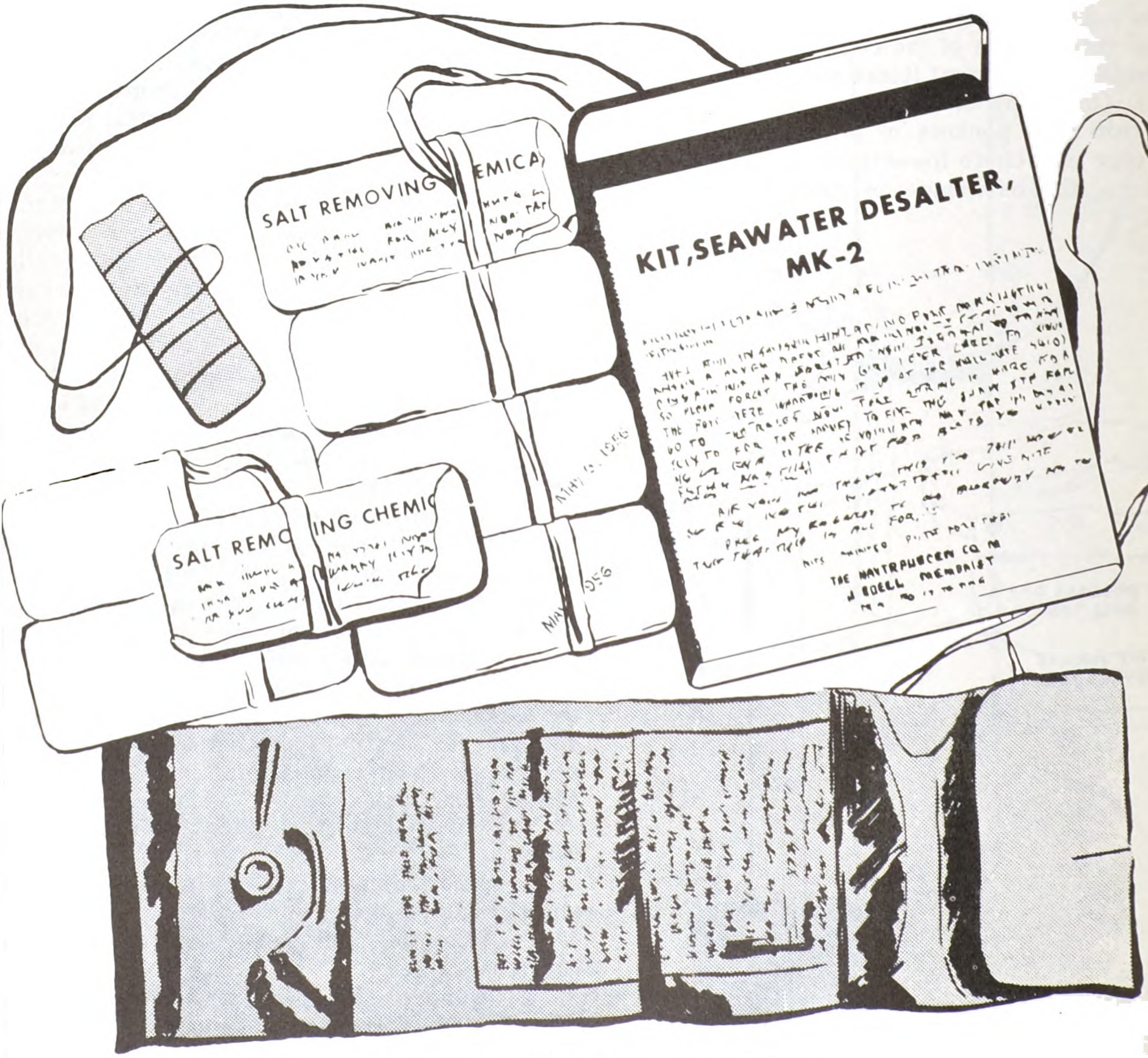


Figure 16-10.—Mk 2 desalting kit.

Solar Still

The purpose of the solar still furnished on life rafts is for distilling water. It is one of the most reliable means by which man is assured an adequate supply of fresh water while at sea. The still operates most effectively in direct sunlight, and will produce approximately two pints of water per day. It will also work on cloudy days if the weather is hot. The water obtained is fresh and pure, and although it may have a harmless plastic-like taste, especially when the still is first used, one can survive on it. The first distilled water may be milky because of the talc which is sprinkled on the inside of the bag at the time of manufacture to keep the plastic from sticking together. With care, the still can be used indefinitely as a source of drinking water.

The solar still is a spherical-shaped envelope fabricated of vinyl plastic film and packaged in a vinyl plastic film container. On each side of the still is an attached line. One is the inflating tube and fresh water drain; the other, a towline with attached hooks. Stills are provided one per rated man-capacity of the life raft. Figure 16-11 (A) illustrates the solar still in a packaged condition; (B) shows the contents of the kit; and (C) illustrates its component parts.

The procedure for operating the solar still follows:

1. Wet the cloth drain on the bottom of the still. This prevents air from escaping through the cloth until the still is fully inflated. The cloth then acts as a safety valve so that the still cannot be overinflated.
2. Inflate the still orally through the inflating tube until the still is round and firm as shown in figure 16-12. The suspension points should indent, indicating that the still is properly inflated. Kinks in the inflation tube will prevent inflation. When the bag is inflated, excess air escapes through the cloth.
3. Place the still overboard in the water, and while holding it upright, fill the reservoir with sea water. When the ballast tube is full, the still will float in an upright position without holding. The reservoir should always be kept full. Refill when water drops to the lower mark on the cup. This should be necessary about once every 1 1/2 hours.

The salt is distilled from the water as follows:

The sun's rays heat the sea water on the black evaporator cloth stretched across the center of each still, causing evaporation. This vapor then condenses on the sides of the plastic cover in the form of beads which run down to the fresh water trap below the ballast tube. The salts, however, do not evaporate, but remain temporarily in the black cloth until washed out the drain at the bottom of the still. The cloth is self-cleaning and need never be washed.

In setting up a new still, throw away the first two-hour output, because the chemical preservative used inside the bag when new will be in the water. To drink the initial output might make one sick.

When operating, the still has a silvery appearance which is caused by condensation of fresh water on the inside of the bag. If the upper half of the bag loses its silvery appearance in spots, pull on the string located in the cup to clear the water feed of foreign matter.

The still has to be topped off with air periodically. The bag should be sufficiently inflated at all times to prevent the cloth from touching the outer bag, because the bag will then become contaminated with salt from the cloth.

The bag may be deflated at night. If it is, turn it upside down until the water runs out and the ballast tube is empty. Rubbing the cloth at the bottom with a dry cloth makes the still easier to deflate when pressure is applied to collapse it. When the still is put in use the next day, it should be drained of fresh water after the first 15 minutes to remove any salt water which may have accumulated inside the still after it was deflated.

While the solar still is surprisingly strong in most respects, it can be cut easily. Therefore, care should be taken to avoid having it come in contact with sharp objects. If the still is cut, it should be repaired immediately with the mending tape. This tape is applied in the same manner as adhesive tape.

Life Raft Paulin

The paulin furnished with life rafts is used for weather protection, water collection, camouflage, as a signal, or as a sail attached to an oar.

The paulin is a rubber-coated (neoprene), nylon-base cloth. When laid out flat it is rectangular in shape. A reinforced hem around the perimeter of the paulin supports a series of grommets. The grommets are provided for utility purposes, making it possible to lace the paulin into many shapes for use as cover, sail, raincatcher, or anything else devised for the occasion.

The weatherproof tarpaulin is colored neon red (older paulins are orange-yellow) on one side and nonspecular blue on the other. The Mk 4 paulin is 72 x 108 inches, and the Mk 7 is 81 x 132 inches.

The paulin may be rigged as a sail to speed raft movement or to navigate the raft in a desired direction. Care should be taken in strong winds to prevent capsizing. The paulin can be stretched across the raft to give protection from

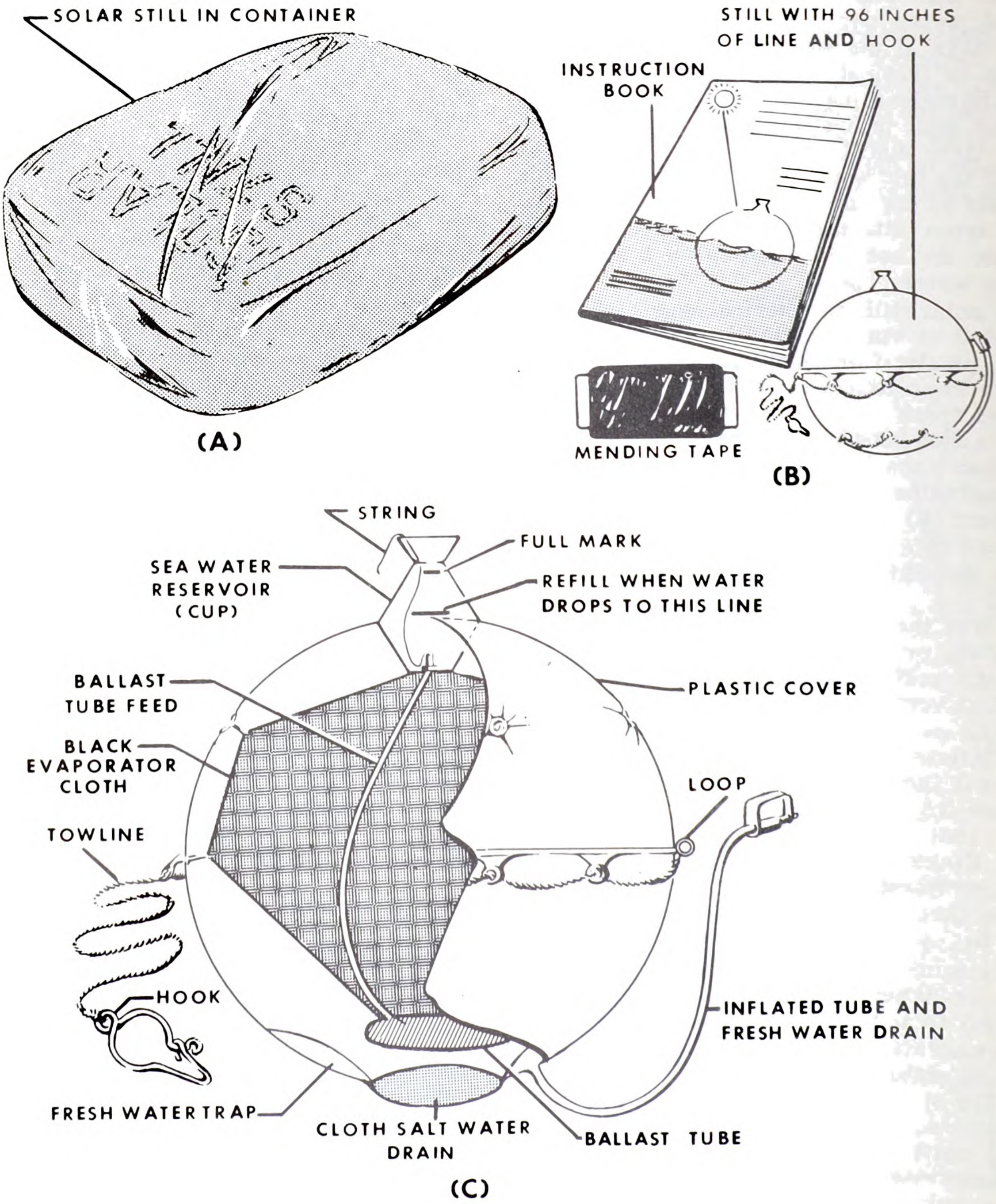


Figure 16-11.—Solar still.

heat and cold. Rain for drinking purposes is collected in a pocket located in the center of the paulin. In signaling with the paulin, refer to the system illustrated in figure 16-13 (A). To insure complete familiarity with these signals it is suggested that periodic drills be conducted in the actual use of paulin for signaling. Standard aircraft acknowledgments are shown in figure 16-13 (B).

Distress Signals

The Mk 13 Mod 0 distress signal is used for day or night distress signaling. The signal may also be used to give wind drift information to helicopters performing pickups of downed personnel.

The Mk 13 Mod 0 distress signal is a pyrotechnic torch that burns approximately 18 seconds. It produces a red glow for night use and orange smoke for day use. Before igniting, select the signal (day or night) to be used.

The night flare can be identified in the dark by a series of small bead-like projections that are embossed around its circumference. After selecting the flare to be used, the sealing tape should then be torn off from around the end of the cylinder and the paper cap removed. (See fig. 16-14.) The pull ring is brought down over the rim of the can and pressed down, using the ring as a lever to break the seal. The ring is then quickly pulled up and as it comes out of the can it ignites the smoke mixture. Smoke will pour out immediately.

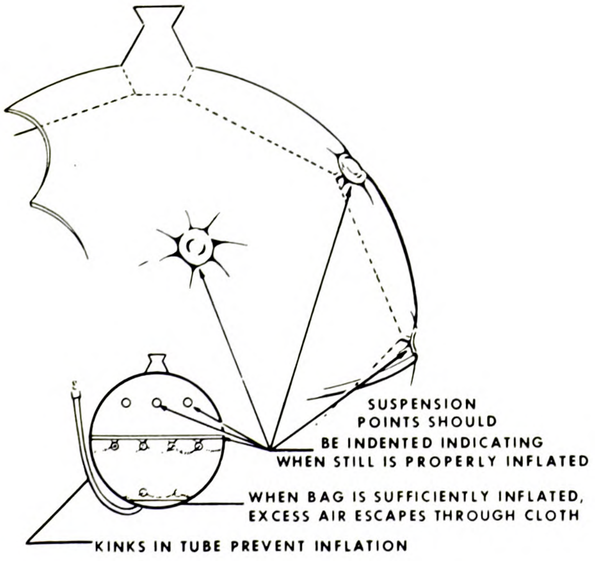

SUSPENSION POINTS SHOULD BE INDENTED INDICATING WHEN STILL IS PROPERLY INFLATED
WHEN BAG IS SUFFICIENTLY INFLATED, EXCESS AIR ESCAPES THROUGH CLOTH
KINKS IN TUBE PREVENT INFLATION

Figure 16-12.—Inflated still showing suspension points

The signal should be held at arm's length and at about a 30-degree angle from the raft. Care should be taken not to drop any of the contents on the user or the life raft. After one end of the signal has been expended, it may be cooled by immersing in water and then saved until both ends have been used. Signals should always be doused in water to cool before being stored.

First Aid Kits

One first aid kit is used with each of the multiplace life rafts and is stowed in the emer-

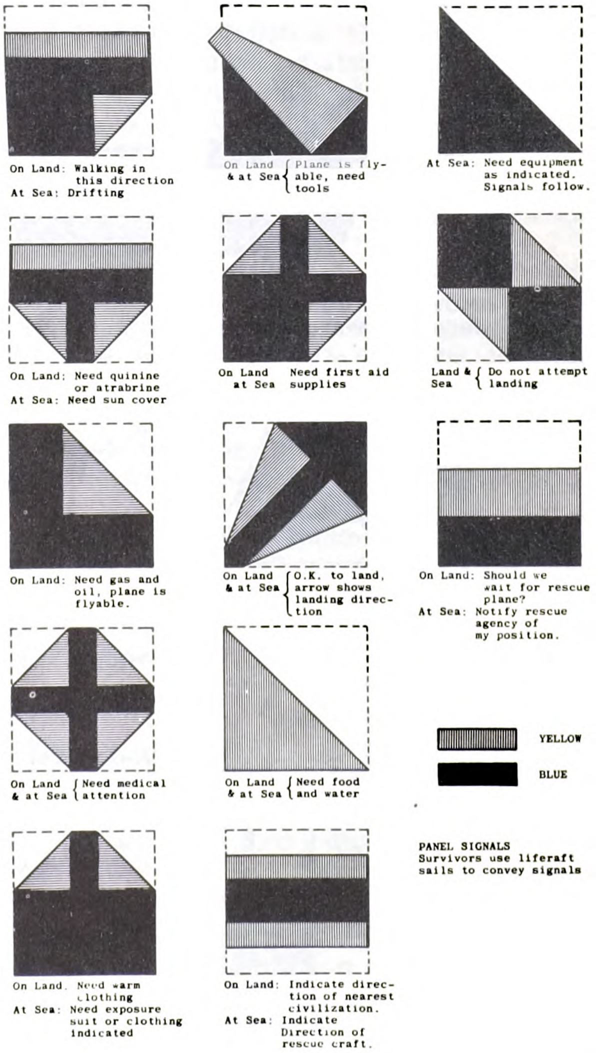

On Land: Walking in this direction
At Sea: Drifting
On Land & at Sea { Plane is flyable, need tools
At Sea: Need equipment as indicated. Signals follow.
On Land: Need quinine or atrabrine
At Sea: Need sun cover
On Land at Sea Need first aid supplies
Land & Sea { Do not attempt landing
On Land: Need gas and oil, plane is flyable.
On Land & at Sea { O.K. to land, arrow shows landing direction
On Land: Should we wait for rescue plane?
At Sea: Notify rescue agency of my position.
On Land & at Sea { Need medical attention
On Land & at Sea { Need food and water
YELLOW
BLUE
On Land. Need warm clothing
At Sea: Need exposure suit or clothing indicated
On Land: Indicate direction of nearest civilization.
At Sea: Indicate Direction of rescue craft.
PANEL SIGNALS
Survivors use liferaft sails to convey signals

Figure 16-13.—Paulin signals and standard aircraft acknowledgments.

gency equipment container. The kit is installed when the raft is put in commission. The directions for the emergency use of the medicine and equipment can be found inside each first aid kit.

The first aid kit is a Bureau of Medicine and Surgery item.

Sunburn Ointment

Sunburn ointment is provided in a small container and should be stowed in the emergency equipment container to prevent it from perishing.

The sunburn ointment should be applied to all parts of the body that are exposed to the sun. For most effective results, rub the ointment well into the skin. The ointment can be used in this same way to give protection from windburn in cold areas.

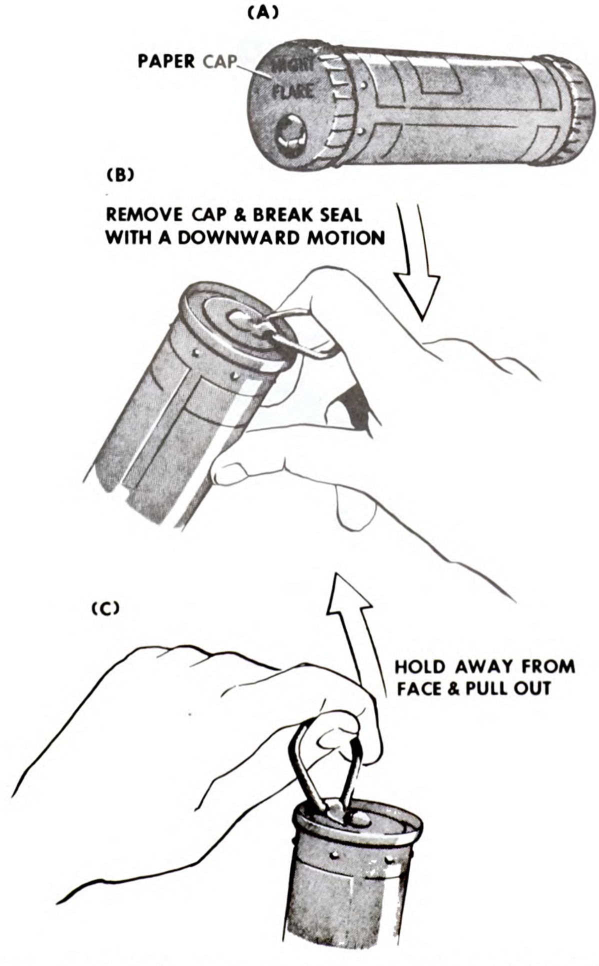

(A)
PAPER CAP
NIGHT FLARE
(B)
REMOVE CAP & BREAK SEAL WITH A DOWNWARD MOTION
(C)
HOLD AWAY FROM FACE & PULL OUT

Figure 16-14.—How to ignite the Mk 13 Mod 0 distress signal.

Rations

Tablet rations are contained in a pneumatically sealed can which can be opened with the key provided. Each unit contains the following:

5 sucrose citric acid tablets
10 sucrose lipid citric acid tablets
2 multivitamin tablets
2 sugar-coated chewing gum tablets
1 waterproof bag and 2 clips for the purpose of preserving unused portions of the rations.

One can of rations should be supplied for each man for which the raft is designed to accommodate. The rations are stowed in the emergency equipment container.

Weights

Life rafts and equipment are designed not to exceed specific weight requirements. Since Parachute Riggers rig, pack and equip life rafts, it is their responsibility to know the weights of the various size rafts and equipment. Often they are consulted on the weights of this equipment, especially when an aircraft is being loaded to capacity. Table 16-1 indicates certain weight specifications, but it should be kept in mind that unforeseen modifications and directives which eliminate or add to the life rafts and their equipment can change their true weights. Therefore, the table is presented as a means of establishing a common ground for estimating purposes which under normal conditions will be reasonably accurate.

Capacities

The nominal capacity value as shown in table 16-2 is desired in order that the specified CO_2 charges may inflate the life rafts to 1 p.s.i. pressure at a corrected temperature of 70° F. and at a corrected standard atmospheric pressure.

To properly inflate the life raft, a cylinder containing the proper charge of CO_2 must be used. To determine the weight of a properly charged cylinder, the empty weight (tare) must be known and should appear stenciled on each cylinder. This tare weight should indicate whether or not it includes the valve head. In weighing the cylinder on a scale, a deficiency in its charge can be readily determined. For example, a cylinder weighs 12 pounds. The tare weight stenciled on the side of the cylinder is

7 pounds. By removing the valve, the cylinder weighs 9.50 pounds, then the cylinder must contain 2.50 pounds of CO_2, the difference between the tare weight and the actual scale weight. Whenever there is any doubt as to whether the tare weight includes the valve or not, expend the gas and reweigh the empty cylinder including the valve. Restencil the cylinder, making certain that the tare weight indicates if the weight of the valve is included.

General Characteristics

Life rafts are designed to withstand a specified maximum internal air pressure of 2.0 p.s.i. without undue leakage over a 24-hour period. Their seam structure and the security of the seams must be strong enough to maintain the security of the raft under all specified conditions.

The life raft inflation system must work smoothly and positively. The inflation tubes must conform to specified measurements in order to contain an air or gas capacity sufficient for maintaining flotation under the prescribed loads. The rubberized fabric used in their construction must be strong enough to meet with all tensile strength requirements as directed by specifications.

The raft fabric must not become damaged when inflated with CO_2 even after the fabric has been subjected to extreme temperatures for a period of 48 hours. Under these conditions, the raft must assume its proper form in a reasonable amount of time. The fabric used in life raft construction must not become cracked or tacky even when subjected to abusive physical treatment and temperatures.

The multiplace life rafts are designed to take punishment under all conditions and treatment in all areas of the globe. The Parachute Rigger, through a series of periodic inspections, preventive maintenance procedures, and minor repair applications, can guarantee a long serviceable life for the rafts in his charge.

Inspection

SCHEDULES

Life rafts are inspected as follows:

Prior to their being placed in service.

Every 3 months thereafter.

Any time doubt exists about their serviceability.

Life rafts in storage are inspected at least once every 6 months.

TEST PROCEDURE

A thorough and complete inspection entails a complete knowledge of the life raft's construction, characteristics, and inherent weaknesses in relation to what is expected in performance during the raft's serviceable life. The longer a raft is in service, the more critical the inspection should be, especially in its ability to hold the prescribed air pressure over the specified testing period.

The most important consideration concerns the ability of a pneumatic life raft to inflate quickly and smoothly, and to support a load for long periods after inflation. Once the inspection procedure has proved satisfactorily that the raft will inflate properly and will hold the internal pressure of its buoyant gas, there are other factors of the inspection to be considered. Completeness of equipment and the condition of each item are very important items and must not be overlooked.

The procedure necessary for a critical inspection follows:

1. Remove the life raft from its container and inflate, USING THE CO_2 SYSTEM. It is important that this system be used in order to check the function of the valves and manifold. Observe its inflating action and the firmness of its form after inflation. After a period of 15 minutes, if the raft lacks the required firmness, it should be deflated immediately and a new charge of CO_2 used. When using a new cylinder it must be charged conforming to exact weight specifications.
2. Remove the CO_2 cylinder and raft retaining line and inspect the inflation manifold threads for damage. Inspect the cylinder for proper marking of hydrostatic test date, legible stenciled weights, and the condition of the cylinder assembly as a unit.
3. Examine the inflation manifold and topping-off valves for leakage by applying a solution of soapy water around their exteriors. Rinse areas thoroughly, and dry.
4. Inspect the entire raft for signs of deterioration and wear, paying particular attention to the edges of all seams and reinforcing patches. Any separations of the fabrics must be cleaned and recemented. Inspect all areas which might have come in contact with exposed metal parts. When the raft is packed, all metal components

Table 16-1.—Weights of life rafts and their equipment.

	Mk 4	Mk 7
Contractor shipped (including GFE and contractor installed equipment).	61 lbs.	76 lbs.
Government installed equipment.	25 lbs.	38 lbs.
Total	86 lbs.	114 lbs.

Table 16-2.—Life raft CO_2 capacities.

	Mk 4	Mk 7
Air capacity, cubic feet:		
Minimum	26.4	38.1
Nominal	26.8	38.7
Maximum	27.2	39.9
Internal volume of CO_2 cylinder, cubic inches	147.0	205.0
Weight of CO_2 charge, pounds	3.25	4.70
Charging tolerances	±.04	±.06
Load capacity (pounds)	1,800	2,500

should be padded with felt or cheesecloth to pre-ent chafing the fabric. Excessive chafing action ot only weakens the fabric used in flotation ubes, but it removes its rubberized coating. This increases the porosity of the fabric, in-reasing the possibilities of leakage in this area.

5. Inspect the topping-off valves for damaged hreads and burred edges. Since burred edges an cut through chafing padding and eventually ut the raft fabric, such rough edges must be emoved from all metal surfaces before the aft can be repacked. After smoothing down a urred area, touch it up with aluminum paint o prevent rust.

6. Inspect the condition of the supply pockets nd their contents. The pocket marked SUP-LIES POCKET AND BAILER, secured to a einforcing patch, contains two large curtain ype (lift-the-dot) fasteners. These fasteners ust release their gripping action, and also old the pocket to the flotation tube properly. See fig. 16-15.)

After the contents of both supply pockets ave been checked, reseal the pocket which is emented to the flotation tube with 1-5/8-inch ape. This pocket is marked SUPPLY POCKET. Cementing procedures are covered later in the chapter.

7. Inspect the security of the lines used to tie pockets, containers, and equipment to the lifeline of the raft. The "bitter ends" of the lines should contain servings. When the ends of the lines terminate in a knot, they should be served to the standing part of the line. Inspect the condition of the lifeline, paying attention to the line supports which are cemented to the flotation tube.

Examine the contents of the accessories container, observing the condition of each article. Make certain the oars contain enough sections of the proper type to be assembled as a whole. Since each section is snapped into place, the pins and springs involved in this action must work smoothly and positively and hold the oar rigidly. The reflecting material cemented to one side of the oar blades must be secure. Each oar section and the completely assembled oar must be able to float in water, and when submerged in any position must rise immediately to the surface.

8. Inspect the life raft retaining line for general condition, length, condition of the end

snap, and for the presence of the instruction tag attached to the end snap. Examine the sea anchor, its securing line, and the security of the mooring patch cemented to the flotation tube.

9. Examine the raft container for proper size and condition. Check for cleanliness, tears, rips, and snags in the fabric. Check for looseness, deformities, and smoothness of operation of all fasteners. Check for clearness and completeness of all markings on the life raft container.

10. Inspect the condition and size of the emergency equipment container. Remove the sealing tape from the container and check the contents. The emergency equipment container must be resealed after this inspection. Examine the container line and snap for condition.

11. After being satisfied that the inspection has been complete and successful up to this point, deflate the raft completely. (Deflating procedures are treated under "Packing.")

12. After the preliminary inflation tests, to check the integrity of the raft and internal bulkheads, the following procedure applies:

a. For accuracy, this test should be made in areas where temperature can be controlled. The ideal temperature for making this and most other tests is 70°F. All pressure readings must be corrected for temperature where it is not possible to conform to ideal conditions. A change in temperature of 1°F. will cause a corresponding change in pressure of approximately 0.03 inch of mercury. Approximate pressure equivalents are given in table 16-3.

b. Alternately inflate the raft chambers through the TOPPING-OFF VALVES with air instead of using CO_2 until each compartment of the flotation tube (in turn) attains the pressure indicated in table 16-4, as measured with a mercury manometer. The use of the mercury manometer for the internal bulkhead check is illustrated in figure 16-15.

Table 16-3.—Pressure equivalents.

Pounds per square inch (p.s.i.)	Inches of Mercury
0.50	1.02
0.75	1.53
1.00	2.04
1.25	2.55
1.50	3.05
2.00	4.07
2.50	5.09

c. Adjust the pressure after one hour to allow for temperature and other changes. After 24 hours, if the pressure is not less than the amount specified in table 16-4, the life raft may be considered sufficiently tight. However, if the raft shows a final corrected pressure of less than the amount specified, the raft must be coated carefully with a soap solution to locate the leak. When applying the soap solution, take care not to work up a bubbling condition. Leaks indicated by the repeated appearance of bubbles must be repaired as discussed later under "Maintenance and Repair." After patching, the test must be repeated. When the life raft has satisfactorily passed the test, it must be rinsed thoroughly with clear water to completely remove all traces of soap, then all parts dried thoroughly.

Table 16-4.—Pressure for life raft check.

Raft size	Raft components	Initial inflation pressure, p.s.i.	Permissible final pressure, p.s.i.
Mk 4 and Mk 7.	Each type compartment (test separately)	2.0	1.25
	Inflatable seats	1.0	0.5
AR-4*	Each tube compartment and top tube (test separately)	2.0	1.25
	Inflatable floor. Test each compartment separately	1.0	0.5
PK-2*		2.0	1.50

*The AR-4 pneumatic life boat (sometimes called life raft) and PK-2 pararaft are included in the table so that this information will not have to be repeated later. Compartments are tested separately as a check on the internal bulkheads.

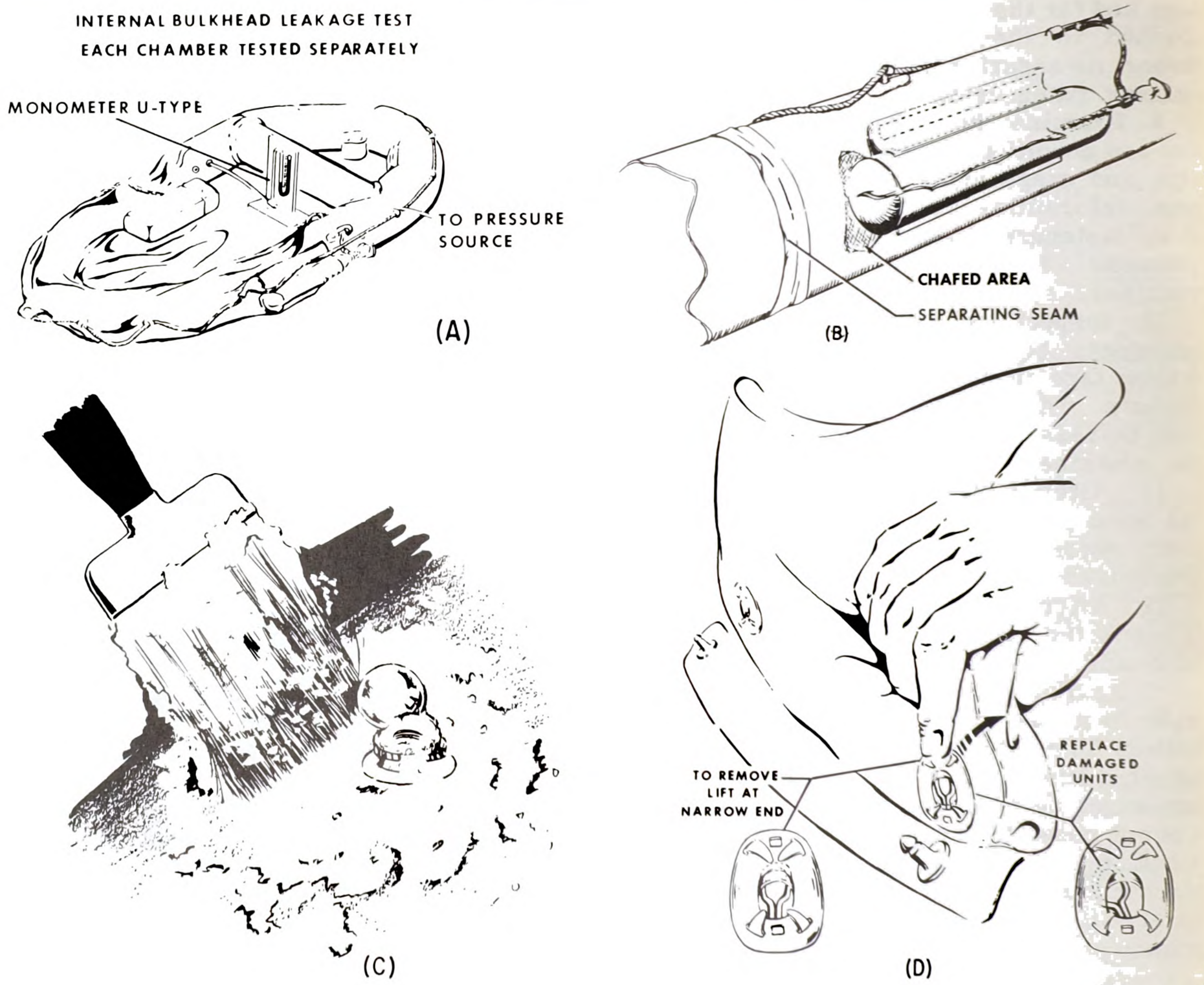


Figure 16-15.—Points of inspection and internal bulkhead check.

SURVEY OF LIFE RAFTS

In accordance with *Aviation Clothing and Survival Equipment* Bulletin No. 16-58, life rafts shall be surveyed under the following conditions:

1. All multiplace life rafts and pararafts which were manufactured prior to 1950.
2. When major repairs are required, such as patching of internal bulkhead, replacing a section of porous flotation tube fabric, or opening of a flotation tube seam for other reasons.
3. All multiplace life rafts which are 5 years of age or older, as determined by the date of manufacture, and fail to pass the pressure check test.
4. Pararafts failing to pass the pressure check test, inasmuch as repair of porous fabric in pararafts is not practicable. If the failure is directly attributable to a cut or tear and there is no porosity, the raft may be repaired.

The disposition of surveyed life rafts is as follows:

1. All usable underage fabric and accessories can be retained and used in the repair or modification of serviceable life rafts.
2. Inflation gear, sea anchors, and other equipment and accessories not required for local use in repair or modification of serviceable life rafts should be shipped to the nearest Aviation Supply Depot for stock, listing the items and quantities shipped.
3. Surveyed rafts may be repaired for ground training and/or recreational use. The number of rafts repaired for such purposes is limited by the

local activity. Life rafts retained under these conditions have the following phrase indelibly stenciled in 1-inch letters on both the raft and raft container: NOT TO BE CARRIED IN AIRCRAFT - FOR GROUND USE ONLY.

Maintenance and Repair

TYPES AND USES OF CEMENTS

The rubber compound used in natural rubber cement is made from the best quality hard Para rubber obtainable. Suitable compounding materials are added in sufficient quantities during manufacturing to insure that the resulting cement will have the desired properties necessary for use with natural rubberized materials. The cement contains a solvent which will evaporate, leaving a flexible film having suitable tackiness, strength, stretch, adhesion, aging, and working qualities for applications involving life raft repairs. The solvents used are BENZOL, SOLVENT NAPHTHA, or a COMBINATION OF BOTH.

Type A natural rubber (self-curing) cement may be a one-part material, or a two-part material consisting of a cement and a separate additive that does not change its characteristics or properties. Type B natural rubber (air-drying) cement is a one-part material substance. Type B cement was made adaptable for use in life raft repair kits, and was supplied in small quantities for this purpose. However, it is no longer being issued for such use as the cement dries up and jells under long indefinite storage periods.

Type A cement is superior to type B cement and should be used wherever practicable. Type B cement is intended for emergency repairs only. However, in the field, it is not always practical to use the self-curing cement as its curing time at approximately 75° F. is 30 days (the curing time directed in the specifications).

Where a sufficient number of spare rafts are available to replace those undergoing repairs, type A cement should be used in preference to type B cement. In the case of type A self-curing cement, follow carefully the instructions marked on the container. Directions which are put out by the manufacturer, such as the method of mixing, the period of time after mixing during which the cement may be used, and any other directions must be followed for successful applications. In the case of type B air-drying cement, the general information printed on the container is all that is needed.

SAFETY PRECAUTIONS IN HANDLING CEMENTS AND SOLVENTS

Cements and solvents are flammable materials and must be treated as such. Never smoke nor permit any type of open flame in the vicinity where any cements or solvents are being used. After the completion of any repair job, always REPLACE THE TOP TIGHTLY. The cement container should be STORED IN A COOL STOREROOM. Common sense and a little precaution will avoid many an accident. WHEN WORKING WITH CEMENTS AND SOLVENTS, CARRY OUT THE PROCESS IN A WELL-VENTILATED LOCATION.

PATCHING PROCEDURES

For patching small holes in multiplace life rafts, cut a patch of rubberized fabric large enough to extend the scalloped edges of the patch beyond the hole or damaged area for a margin of 1-1/2 to 2 inches.

If the tear or cut is of sufficient size to permit the entrance of the hands and a brush on the inside of the flotation tube, patch the affected area from the inside as well as from the outside. Should the damage be in the form of a cut or tear having no material missing, do not overlap the cut but always butt one edge of the cut to the other when contacting the patch. To prevent cement from coming in contact with undamaged internal tube surfaces, use an appropriate piece of holland cloth under the damaged area being coated. This will keep the opposite internal surface from sticking to the repaired area. In some cases, the holland cloth will have to be left inside the repaired flotation tube.

Life raft patching procedure is as follows:

1. Before scalloping, place the patch over the hole and mark off the damaged area, following the lines of the patch. Scallop the edges of the patch with pinking shears and round all corners.
2. Clean the marked area and the underside of the patch thoroughly with a medium stiff bristle brush dampened with Stoddard solvent and allow the patch to dry.
3. Thin a small quantity of cement by adding an equal amount of solvent, and mix well.
4. Brush this thinned cement into the washed area filling the edges of the tear or cut as much as possible. The first application of thinned cement is designed to penetrate the pores of the fabric and thereby build a good base for the final heavier coats. After the first coat is dry, trim off all ravelings, threads, or twisted edges.

5. Apply one more coat of thinned cement; also, apply two coats of the thinned cement to the patch. Allow to dry 5 to 15 minutes.

6. Apply two additional coats of regular strength cement to the damaged surface and two coats to the patch. Allow the third coat on the respective surfaces to dry before applying the fourth.

7. When the fourth coat becomes tacky, apply the patch carefully to the damaged area so that it will not have to be torn off and reset. Lay it over the damaged area and roll it down, being careful not to trap air between the cemented surfaces. When using a steel roller, keep the roller flat so that its sharp edges will not cut the fabric.

8. Twenty-four hours after the repair, check the life raft for leak tightness.

Loose seams, chafing patches, oar patches, and other similar patches can be recemented following the applicable cleaning and patching methods outlined. If, after the tape over a tube seam has been recemented in accordance with instructions, the leak still persists, seeping through the rubberized fabric near the seam, it is an indication that the seam or the tape holding the seam inside the raft is defective. In this case, survey the life raft. All seam and patching repairs affecting the flotation tube of the raft must be checked for leak tightness by employing air pressure and a mercury manometer to ascertain the effectiveness of the repairs.

CLEANING

If a general cleaning is necessary, the life raft should be cleaned only with a mild soap. Avoid the use of coarse scrubbing brushes in the cleaning process, as this practice will damage the fabric, causing leakage. All traces of soap must be removed by a thorough rinsing with clear fresh water. After rinsing, dry the life raft with a sponge. When the raft is dry, dust with talc.

To remove old cement, grease, paint, or other similar stains from the raft, it is permissible to use Stoddard solvent or some other suitable safety solvent. Extreme caution must be exercised in the use of solvents since they dissolve rubber. When a stain cannot be removed completely, if it is not injurious to the fabric, it is better to leave it alone than to continue harsh removal methods. Any stain bears watching, and should be tested for its acid or alkaline content whenever the life raft is inspected until the nature of the stain has proven to be noninjurious.

Packing Multiplace Life Rafts

EQUIPPING THE LIFE RAFT

The types of equipment and the stowage places concerned have been previously discussed in this chapter. However, Parachute Riggers must be on the alert to the possibilities of additions to and deletions from this equipment. The best procedure is to see that multiplace life rafts are equipped in accordance with latest directives and bulletins. The past use of certain basic survival equipment is a reasonable guide to their continued use, but is no guarantee of their continued use when new and improved equipment and/or survival methods are developed.

FOLDING THE LIFE RAFT

In order to enclose life rafts in their protective carrying cases, they must be folded and rolled in a completely deflated condition. Properly packed in their carrying cases, they are ready for immediate use and can be stowed in any convenient location in the fuselage of an aircraft.

Figures 16-16 through 16-22 illustrate the packing procedure for a Mk 7 life raft. The Mk 4 life raft is packed in the same general manner.

The following general applications apply to packing multiplace life rafts:

1. After the survival equipment has been stored in the pockets and containers provided,

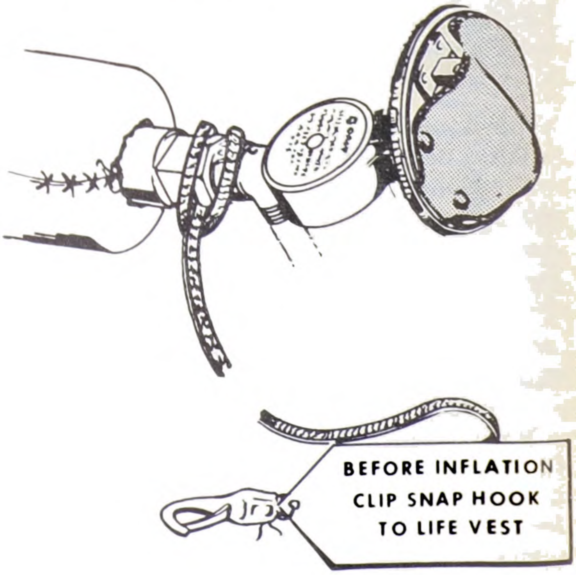


Figure 16-16.—Application of the life raft retaining line.

seal the applicable pockets and containers in accordance with latest directives.

2. Attach a fully charged CO_2 cylinder of the proper size to the inflation manifold, making certain that the life raft retaining line is properly connected to the neck of the cylinder. The instruction patch or tag should be attached to the snap as shown in figure 16-16.

3. Completely deflate the raft using a vacuum cleaner or some other suitable suction device by applying suction at the topping-off valves of the flotation tube. Where applicable, deflate the inflatable seats.

In order to pack life rafts in their carrying cases properly, every trace of air or CO_2 must be removed from the flotation tubes. Gas trapped in these chambers can prevent folding the rafts compactly. If a raft is packed in this condition, the trapped gas will expand at high altitudes. This will pose a dangerous hazard to the construction of the life raft and also possibly to the flight efficiency of the aircraft involved. When deflating, it is necessary to keep the OPPOSITE INTERNAL SIDE OF THE TUBE FROM BLOCKING OFF THE APPLIED SUCTION. Each respective topping-off valve must be closed tightly by hand. As the gas is being exhausted from the tube, continually close off the valve. This application prevents the entrance of small quantities of outside air into the deflated chamber as the valve is being closed. The proper procedure for deflating a life raft is illustrated in figure 16-17.

4. Dust the entire life raft with talc, a common soapstone preparation. Make certain that all surfaces are dusted, particularly under the flotation tube where the bottom is connected. The talc acts as a very mild abrasive. It is designed to prevent the fabric from sticking together, and thereby insures a smoother unfolding action when the life raft is inflated.

5. Check the life raft righting handles for entanglement, the security of the emergency equipment container retaining line to the raft, and the emergency equipment container. Also, check the security of the accessories container retaining line. If not already done, make certain that ALL EQUIPMENT IS LASHED TO THE LIFE RAFT to prevent loss when the raft is inflated. Across the top centerline of the flotation tube in 1-inch black letters must be stenciled the words LASH ALL EQUIPMENT TO RAFT TO PREVENT LOSS. Check for security and clear the sea anchor and its securing line from the raft. Apply chafing material around all exposed metal fittings that can damage the life raft fabric.

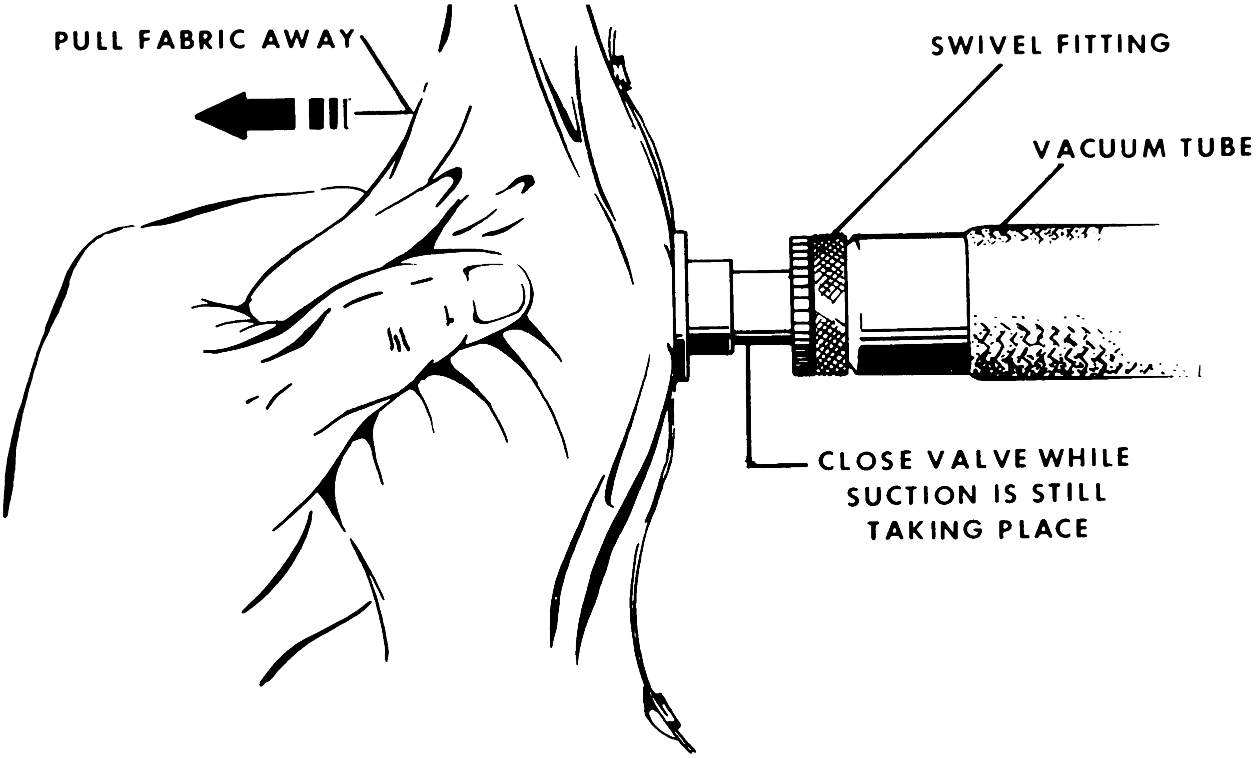

PULL FABRIC AWAY
SWIVEL FITTING
VACUUM TUBE
CLOSE VALVE WHILE SUCTION IS STILL TAKING PLACE

Figure 16-17.–Deflating the life raft.

6. Before the life raft is folded and rolled around its accessory container, align and position the container to allow for proper folding of the raft, as shown in figure 16-18.

7. Lay out the life raft carrying case, and check the condition of all the snap fasteners. Talc the inside of the case.

8. Fold and roll the raft as illustrated in figures 16-19, 16-20, and 16-21, keeping the raft retaining line and emergency equipment container retaining line clear for their final application. The sea anchor retaining line is coiled or faked down ON THE TOP FOLD and the sea anchor is placed ON TOP OR OVER THIS LINE. In this location, it is prepared for immediate action when the life raft inflates and ejects the sea anchor into the water.

As an aid in holding the life raft closed temporarily before the raft carrying case is placed around the raft and fastened, one or two closing straps can be applied around the body of the life raft. Application of these straps prevents the tightly rolled raft from unrolling or slipping, which makes the final closing operation difficult. WHENEVER CLOSING STRAPS ARE USED, THEY MUST BE REMOVED BEFORE THE LIFE RAFT CARRYING CASE IS COMPLETELY CLOSED.

9. The top part of the CO_2 cylinder inflation valve or its actuating pull handle must be located accessibly, as illustrated in figure 16-22. This figure also illustrates the life raft completely packed in its carrying case and attached to the emergency equipment container.

10. Secure a tag indicating the inspection and packing date to the outside of the life raft carrying case and near the CO_2 pull. The Parachute Rigger responsible for the inspection, test, and packing, should sign this tag.

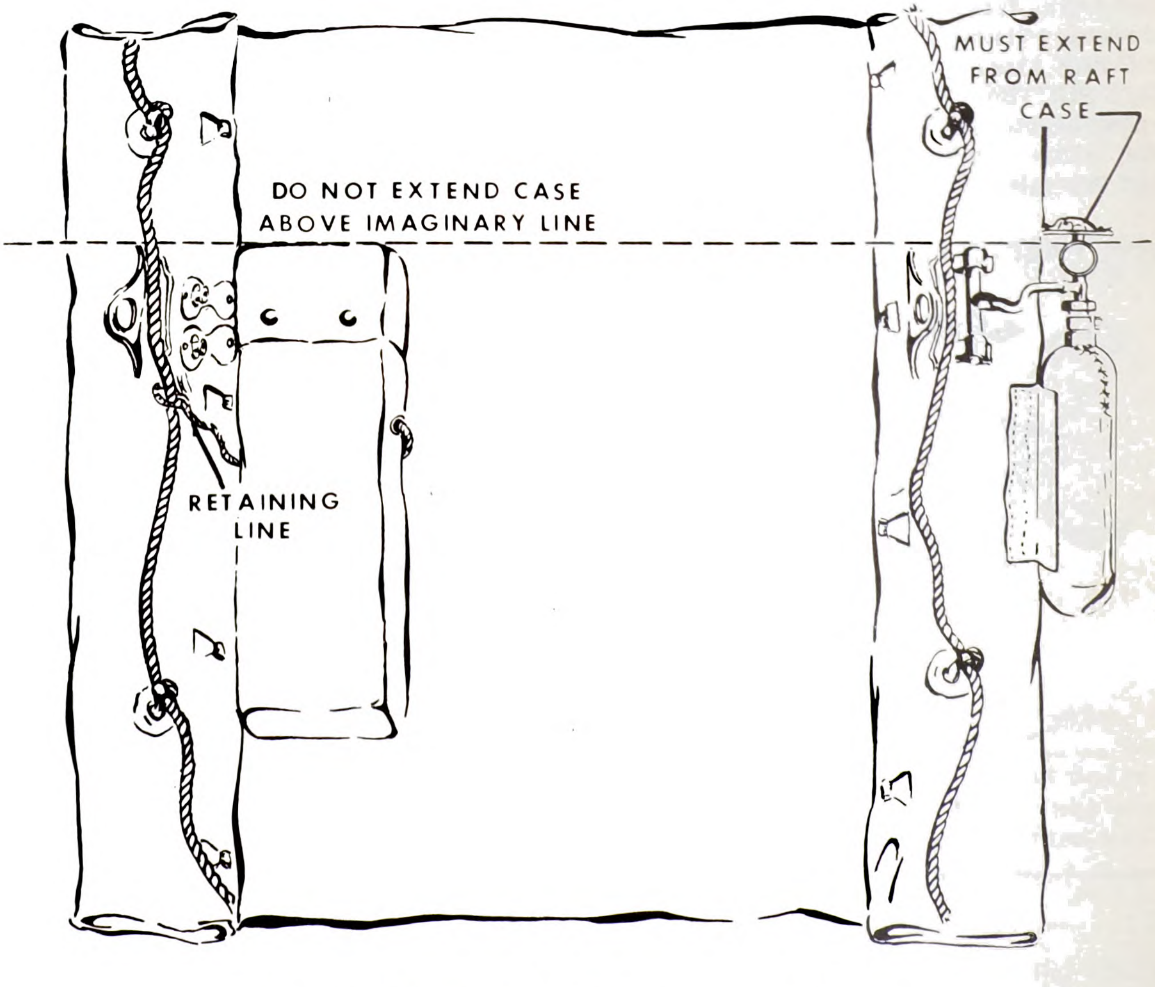


Figure 16-18.—Position of the accessory container.

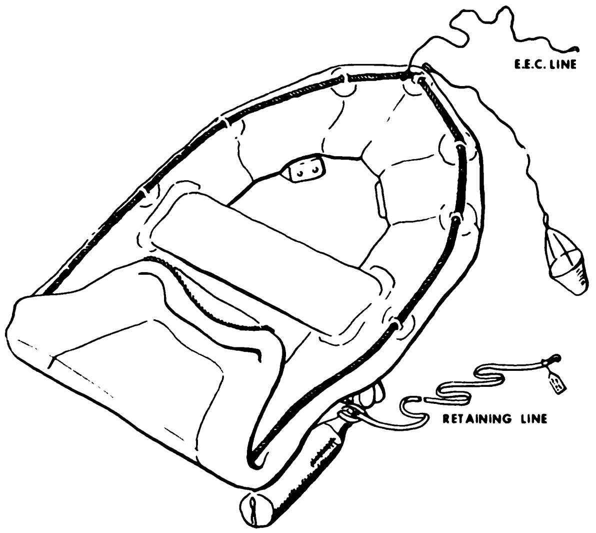


Figure 16-19.—Folding the life raft.

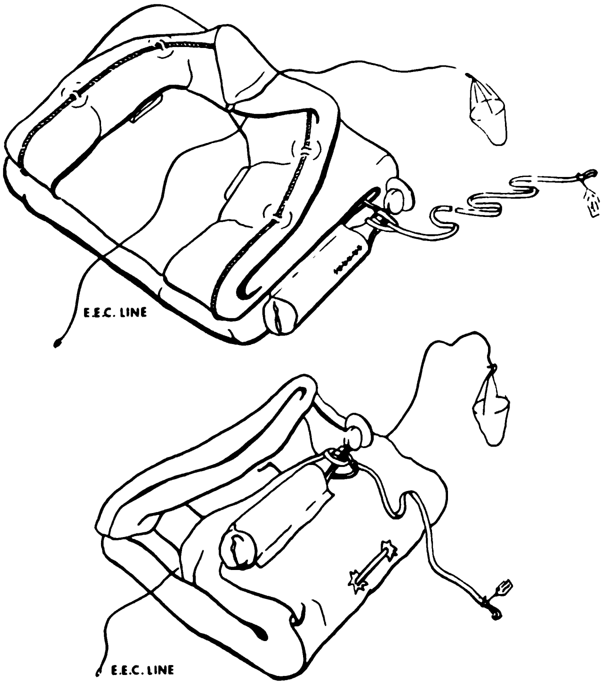


Figure 16-20.—Rolling the life raft.

STENCILING RUBBERIZED FABRIC

For marking rubberized fabric any black, waterfast, vegetable base paint is suitable when using simple field stenciling methods. This would include the use of fiber cut or metal adjustable type stencils and a round, tightly set, bristly brush to apply the paint sparingly. All obliterated or new markings on rafts and their accessories must be restored or be made in accordance with specifications and/or superseding publications. For example, the size or MARK number of a life raft should be stenciled on the raft and on its corresponding carrying case in 2-inch letters and the date of manufacture (month and year) in 1-inch letters. When publications fail to state the exact size lettering to use in a phrase such as, WARNING: LASH ALL EQUIPMENT TO RAFT TO PREVENT LOSS, its significance or value must be considered in relation to the size of the area in which it is to appear. In short, the size of the stenciled letters must be determined by the application of good judgment consistent with the size of the item to be stenciled and the importance of the phrase.

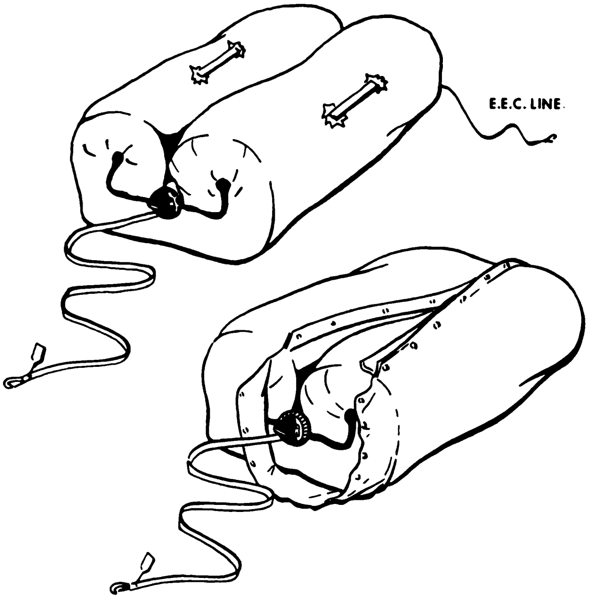


Figure 16-21.—Enclosing the life raft in its case.

PK-2 PARARAFT KIT

The pararaft kit (PK-2) is a 1-man life raft. The number 2 in the symbol indicates that this is the second model. When new and improved pararafts are designed, a new model number will be assigned.

The methods of rigging the pararaft to the various types of parachutes have been discussed in other chapters of this training course. This section is therefore limited to describing the components of the PK-2 and its equipment and the

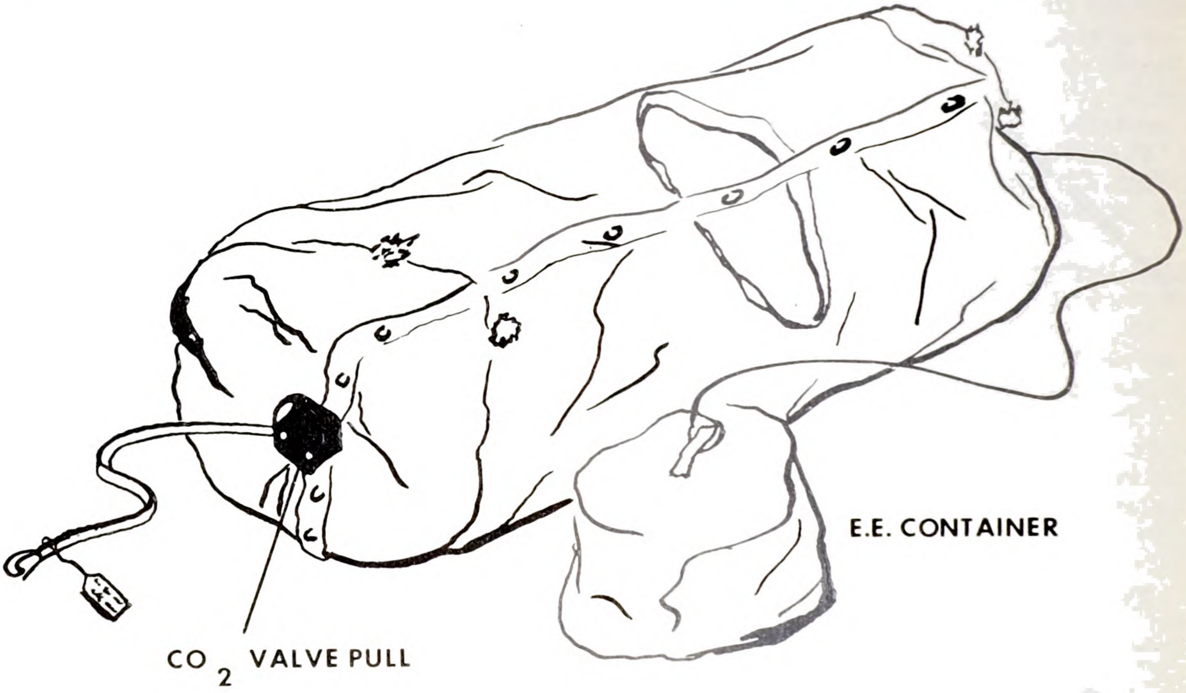


Figure 16-22.–Position of CO_2 cylinder actuating valve pull.

procedures for performing inspections and maintenance. Procedures which parallel those already outlined for multiplace life rafts are not repeated.

Description of Components

FLOTATION TUBE

The body of the pararaft consists of an encircling buoyant tube tailored to form the shape shown in figure 16-23. The flotation tube is made in one continuous chamber from type H fabric. There are no internal bulkheads as in the multiplace rafts. The fabric bottom is applied with a sufficient amount of slackness to prevent distortion of the flotation tube when the raft is inflated.

SEAMS

All laps used in the seam construction of the flotation tube are 5/8 inch wide, covered inside and out with type F tape, 3/4 inch wide.

CYLINDER CARRIER

Figure 16-23 shows the location of the cylinder carrier on the flotation tube. The cylinder carrier is 2 inches in diameter.

ORAL INFLATION TUBE

The valve on the oral inflation tube closes automatically by spring pressure when it is not held open. The valve is locked shut by turning the mouthpiece in a clockwise direction. The 3/8-inch oral inflation tube is cemented to the valve at one end, and at the other it is equipped with a molded flange which is cemented to the flotation tube.

BOARDING STRAPS

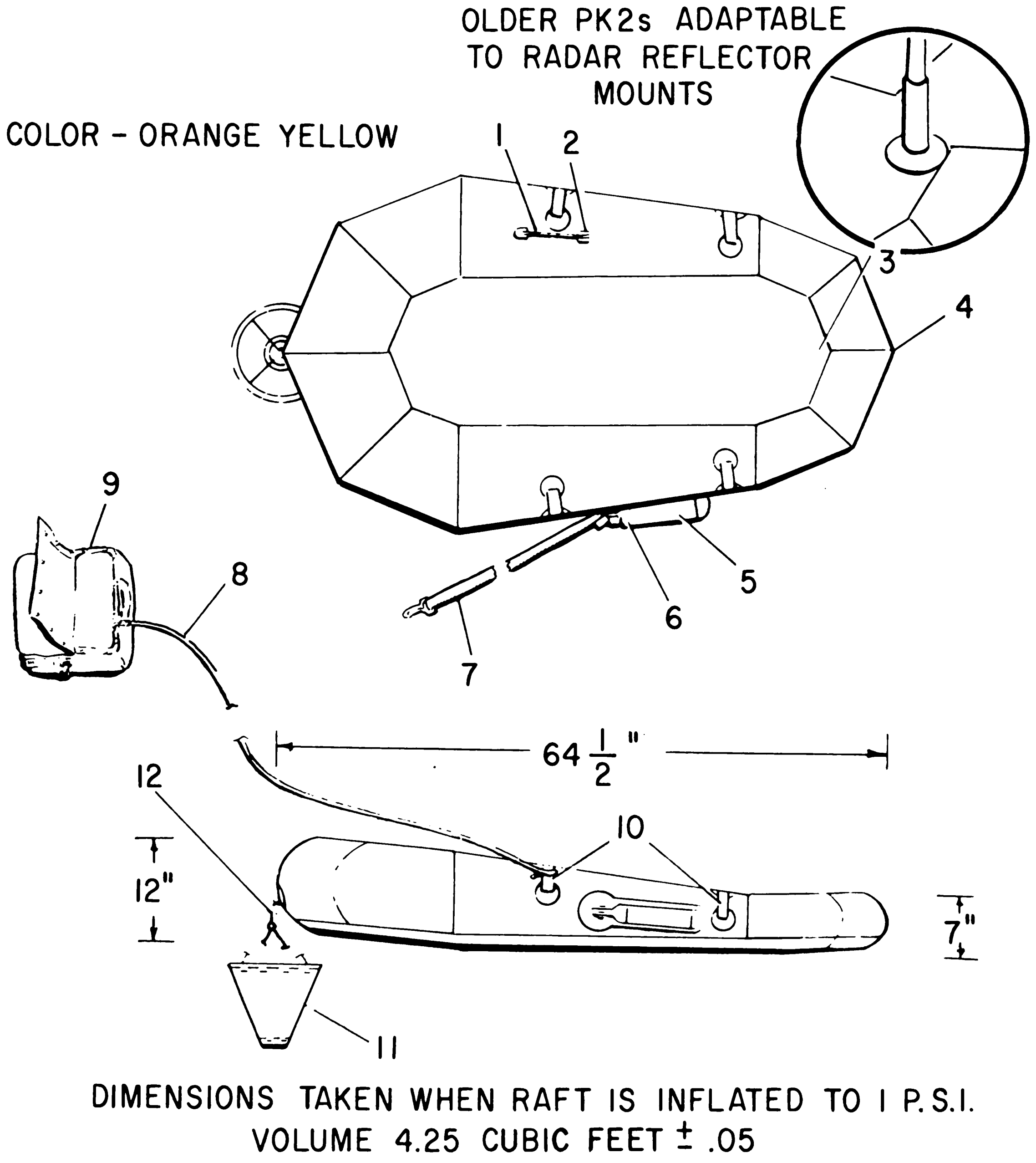
Four handles or straps are provided as aids for boarding the life raft.

INFLATION SYSTEM

The flotation tube is inflated with a CO_2 charge weighing 0.5 pound. The CO_2 cylinder is mounted in the cylinder carrier and the cylinder valve is threaded into the inlet check valve of the pararaft.

SEA ANCHOR

The sea anchor is tied to the pararaft mooring line with type III nylon line, using a bowline knot; the other end is tied to the sea anchor mooring patch with a square knot. The bitter


OLDER PK2s ADAPTABLE TO RADAR REFLECTOR MOUNTS
COLOR - ORANGE YELLOW
1
2
3
4
5
6
7
8
9
64 1/2"
12
12"
10
7"
11
DIMENSIONS TAKEN WHEN RAFT IS INFLATED TO 1 P.S.I.
VOLUME 4.25 CUBIC FEET ± .05

1. Oral inflation tube valve.
2. Valve pocket.
3. Radar reflector mount.
4. Stern.
5. Cylinder carrier.
6. Cylinder.
7. Retaining webbing.
8. Securing line.
9. Raft case.
10. Handles.
11. Sea anchor.
12. Mooring sea line.

Figure 16-23.—PK-2 pararaft.

ends of both knots are served with nylon thread to prevent them from untying. Before tying the knots, the ends of all nylon line are HEAT FUSED to prevent fraying.

SECURITY LINE

The securing line is a 5-foot length of nylon cord. This line is used to secure the pararaft to its carrying case and equipment. The line is tied with a square knot to the pararaft sea anchor patch. The other end is also tied with a square knot through the grommet in the pararaft case. The free ends of the knots are bound or sewed with type B nylon thread.

WEBBING LANYARD

A nylon webbing lanyard 1-inch wide and 2-feet long is provided to secure the pararaft to the user. One end of the lanyard is equipped with a 1 1/8-inch snap hook. The other end is secured to the CO_2 cylinder neck by means of a loop formed at the end of the webbing, encircling the cylinder neck.

MARKINGS

Printed in 1/4-inch black letters on a white patch adjacent to the oral inflation valve, the following instructions are printed: TO INCREASE PRESSURE: PUSH DOWN VALVE MOUTHPIECE AND IMMEDIATELY BLOW THROUGH INLET.

Each pararaft is durably marked at the large end in black stencil ink with the following:

	Letter Height
PARARAFT - MODEL PK-2 . . .	1"
BUAER SPEC	1/2"
NAME OF MFGR	1/2"
CONTRACT NO	1/2"
DATE OF MFGR	1/2"

PARARAFT CASE

The raft case is constructed of 2-ply ripstop nylon fabric, coated with a crude rubber compound between the plies. The color of the case is the same as the raft.

Each case is marked with black stencil paint in 1/2-inch letters on the side opposite to the snap fasteners. The information indicates the model number and specifications. Figure 16-24 illustrates the general appearance of the PK-2 pararaft and shows the location of the inspecting and packing data pocket. The information shown in this illustration is stenciled on the side of the case as indicated.

INSPECTION CARD

The inspection card may consist of a 3 x 5 inch printed card, containing the following information:

DATE	(date of inspection & packing)
RAFT NO. . . .	(raft number locally assigned)
EQUIPMENT . .	(completeness & condition check)
SIGNATURE . .	(Parachute Rigger responsible)

In addition, each card should contain information relative to the model number, specification number, and designation numbers of the publications directing modifications of the equipment.

Equipment

CONTRACTOR FURNISHED AND INSTALLED EQUIPMENT

The following equipment is installed in the equipment section of the pararaft case: A PONCHO, WATER STORAGE BAG, and NYLON LINE.

GOVERNMENT FURNISHED AND CONTRACTOR INSTALLED EQUIPMENT

The following equipment is installed in the equipment section of the pararaft case with the other items: A DESALTING KIT, SOLAR STILL, SIGNALING MIRROR, TWO DYE MARKERS, and TWO DISTRESS SIGNALS (Mk 13 Mod 0).

GOVERNMENT FURNISHED AND INSTALLED EQUIPMENT

One MX-138A/A radar corner reflector is installed in the equipment section of the pararaft case. This reflector is smaller than the one used in multiplace life rafts. A copy of the GROUND/AIR EMERGENCY CODE (NavAer 00-25-5313) is installed in the pararaft case inspection card pocket, along with the inspection card.

To make the pararaft adaptable for rigging to parachutes, a pararaft kit container is provided with each pararaft case. In spite of the fact that both the pararaft case and pararaft container contain something, do not confuse them. The kit container contains the case, which contains the pararaft and equipment. Each container is marked in black stencils 1-inch high, PARARAFT KIT CONTAINER FOR USE WITH MODEL PK-2 PARARAFT KIT. Figure 16-25 illustrates the stowage arrangement of the contents in the equipment section of the pararaft case. Also shown in this figure is the pararaft kit container. The weight of the entire

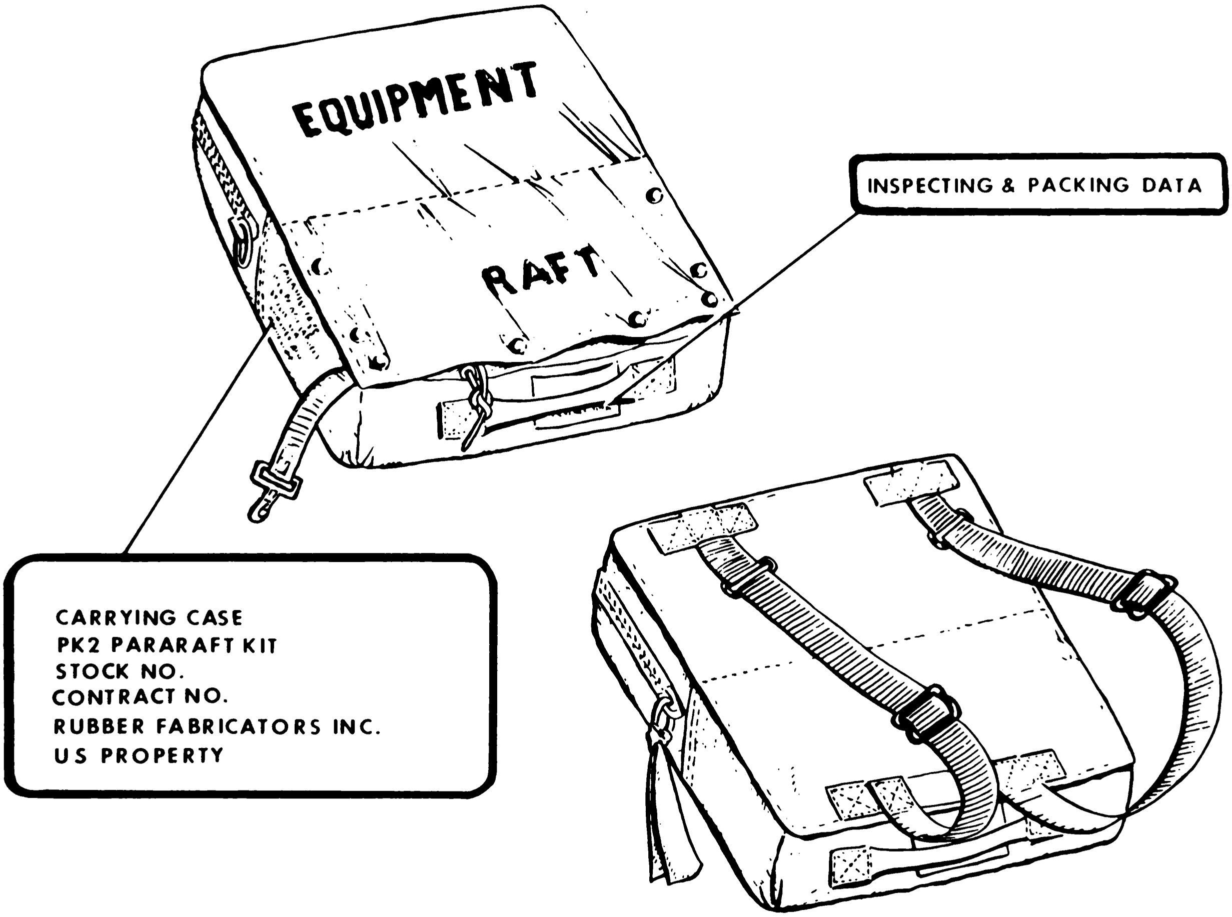


Figure 16-24.—PK-2 pararaft case.

pararaft assembly, including the container, is approximately 19 pounds.

Inspection

SCHEDULE

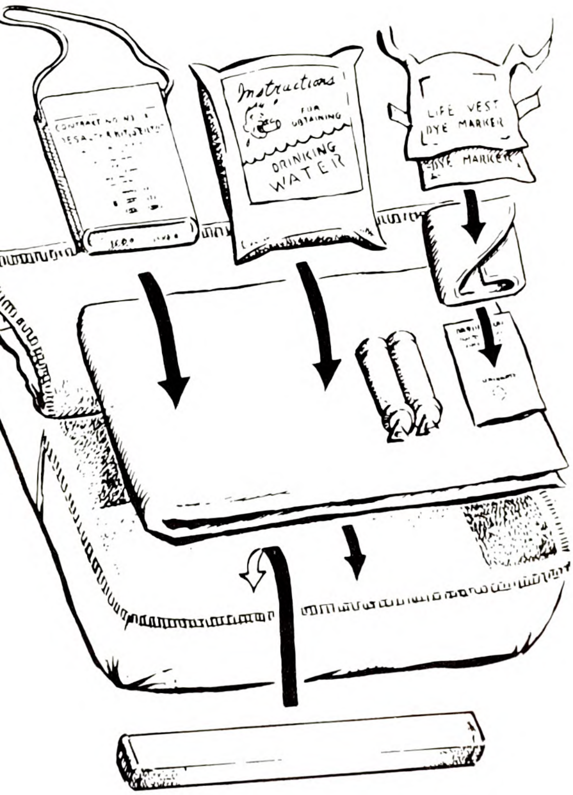
Pararaft kits are inspected at the following times:

Prior to being placed in service.
Every 3 months after being placed in service.
Every 6 months in storage.

Pararaft kits that are rigged to seat type parachutes require a closer inspection than those rigged to the chest type because of the weight imposed upon them. The individual's weight causes trouble in the form of chafed and badly damaged materials, bent objects, and an overall impacted condition. Every time parachutes containing pararaft kits are repacked, the equipment should be rearranged and inspected closely, keeping weight factors in mind.

In addition to the trouble caused by the applied weight, another consideration is also important This concerns flatness and smoothness of the entire assembly. An improperly packed pararaft causes discomfort and fatigue to those who sit on them, even though they are separated by a cushion containing a metal pan.

When pararafts are being used every day, inspect the condition of each pararaft where the cylinder is liable to chafe the raft fabric. Chafing gear sometimes shifts or is worn through when subjected to hard usage. Also examine the inlet valve, where it joins the tube, for cracks or signs of breaking away. This inspection does not require the removal of the raft from its case, only the opening of the front section of the case.



igure 16-25.—Stowage arrangement of the pararaft equipment.

OCEDURE

The procedure for inspecting and testing the araft are the same as those given for the ltiplace life rafts. Where there are con-erable differences in their construction, tain steps may be eliminated or added as essary. For example, pararafts are not structed with internal bulkheads. Since there nly one continuous flotation tube, the internal khead test is not necessary on the pararaft. e pararaft is fitted with an oral inflation tube, it serves the same purpose as the topping- valves on the multiplace life rafts. There-e, the same general considerations given topping-off valves should be applied to the l inflation tube. Although the exposed end of oral inflation tube has no rough edges, it is t in a supporting pocket.

Packing

Prior to commencing the packing procedure, ke certain that the pararaft is completely deflated. Careless or improper deflation of inflatable equipment will result in expansion at high altitudes, causing severe discomfort or danger to personnel and aircraft. Higher altitudes cause progressively greater expansion. Entrapped air which causes discomfort at 25,000 feet may pin a pilot to his cockpit at higher altitudes.

Completely collapse the oral inflation compartment by use of a suction pump. SCREW LOCK ORAL INFLATION TUBE.

Figures 16-26, 16-27, 16-28, and 16-29 illustrate the sequence of the steps in packing the PK-2 pararaft. Each item in the equipment side of the case should be secured in train to prevent loss. The looped end of the webbing lanyard, attached to the cylinder neck, must not interfere with the action of the valve pull. The valve pull-toggle must be placed in an accessible position. After the packing is completed, the responsible Parachute Rigger must sign the packing card enclosed in the pararaft case.

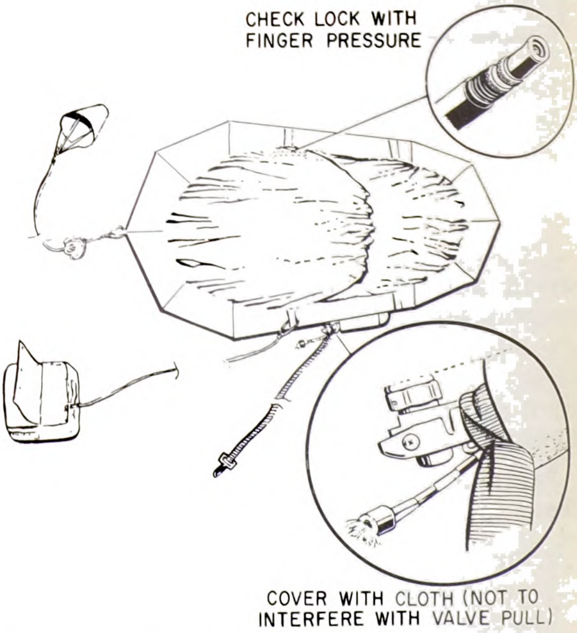


Figure 16-26.—Laying out the PK-2 pararaft.

Maintenance and Repair

CLEANING

The procedure for cleaning the pararaft is the same as that given previously for multiplace life rafts.

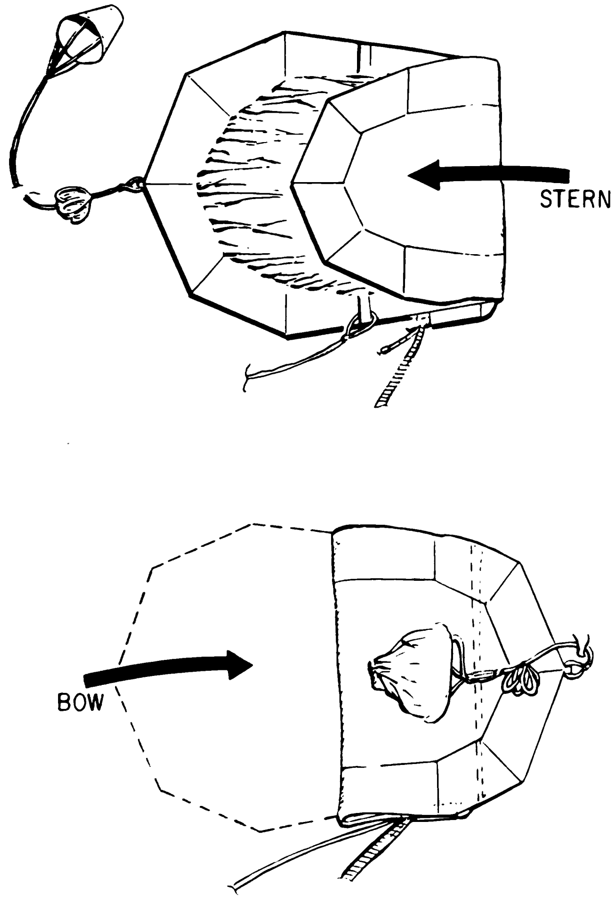


Figure 16-27.—Folding the pararaft.

PATCHING

For patching purposes, type H fabric is recommended since pararafts are constructed of lightweight material. A 1 1/2-inch overlap should be allowed when cutting the patch. Defective seams may be repaired by cementing, as described previously for multiplace life rafts, except flotation tube seams and seams attaching the tube to the bottom. These seams are not repairable under any circumstances.

AR-4 DROPPABLE BOAT

The AR-4 lifeboat is designed to be dropped from the bomb bays or bomb racks of aircraft at altitudes of 100 to 150 feet and at an indicated airspeed of 100 knots. The assembly is designed to accommodate four survivors.

In the packed condition the assembly is 41 inches in length and 16 inches in diameter. Total weight is 110 pounds. It may be carried within the fuselage or cabin of large aircraft and dropped by hand from hatches. Two adjustable supporting straps are supplied with the container so that the unit may be slung torpedo fashion between the bomb racks. These straps are attached to the container in such a manner that in the event that only one bomb rack is released, the strap will pull free from the container and not impede the fall of the assembly.

The AR-4 shown in figure 16-30 is a 4-man pneumatic lifeboat of double tube construction. The boat is complete with a sailing rig, mast, rudder, keel, weather shield, sun canopy, sea anchor, and an inflatable floor. After inflation, the boat is 9 feet 3 inches long and 5 feet 3 inches in beam

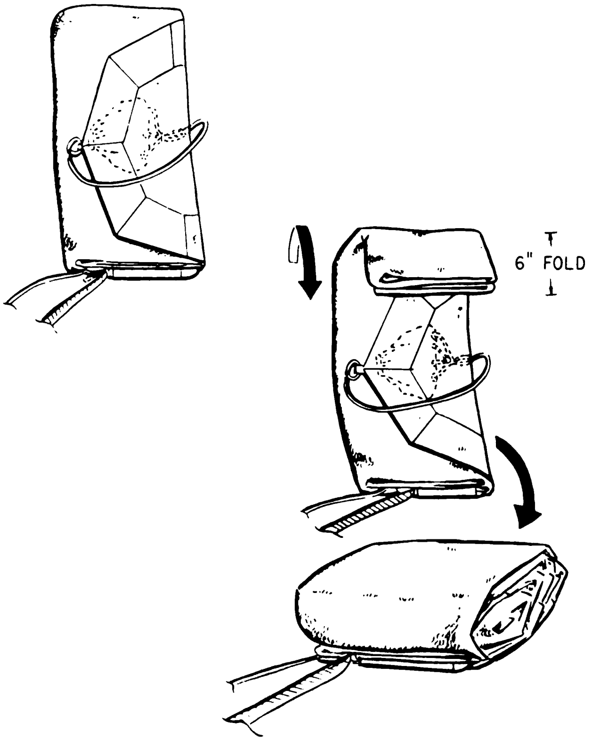


Figure 16-28.—Making the side folds.

Inspections

As on all pneumatic survival equipment, the AR-4 must be thoroughly inspected prior to packing. The following inspections, as applicable, must be conducted on the AR-4 assembly:

Prior to being placed in service.

Every 6 months thereafter.

1. Inflate the boat with the installed inflation system to ascertain that all parts of the equipment perform properly.

2. Inspect all the metal parts for evidence of corrosion, and examine the body of the boat, weather shield, spray tube, and inflatable floor for deterioration.

3. Remove the CO_2 cylinder from the boat and check the manifold for leakage with a soapy water solution.

4. Deflate the boat using a suitable deflation or suction pump to insure complete removal of all CO_2 gas.

5. Inflate one compartment of the boat with air to 2.0 p.s.i. pressure. Remove the cap from the topping-off valve on the deflated compartment. After 1 hour, again check the pressure and adjust, if necessary, to the original pressure of 2.0 p.s.i. Note temperature, and allow the compartment to remain inflated for 24 hours.

6. Conduct the same test on the other compartment of the boat.

7. Test the spray tube in the same manner as the main tube compartment.

8. Make correction of any temperature changes. If the pressure of either compartment or spray tube drops to less than 1.25 p.s.i., consider the boat unfit for issue and check it further for leaks. If practicable, the leaks should be repaired.

9. Test each compartment of the inflatable floor as above with the exception that the initial pressure should be 1.0 p.s.i. with a drop to 0.5 p.s.i. permitted after 24 hours.

10. Deflate the boat. Use a deflation or suction pump to insure complete removal of air.

11. Attach a correctly charged cylinder to the manifold and tighten all connections.

12. Check all sailing, signaling, and survival equipment for completeness, proper stowage location, and where practicable, operation.

13. Examine the raft case for oil and acid stains, and for any visible defects or deterioration likely to damage the contents of the case.

Packing Instructions

The AR-4 boat must be deflated completely before the packing procedure is started. Spread the boat flat so that the gear may be stowed on it. Fold each side toward the middle and on top of all the stowed gear. The CO_2 actuator control cable must fall on top of the starboard fold in a manner so that it can be operated after the boat is rolled.

Roll the boat from each end toward the CO_2 cylinder at the center. When rolling from the bow to the cylinder, care must be taken in order that the keel cable will not foul during the inflation of the boat. The cable is held as near as

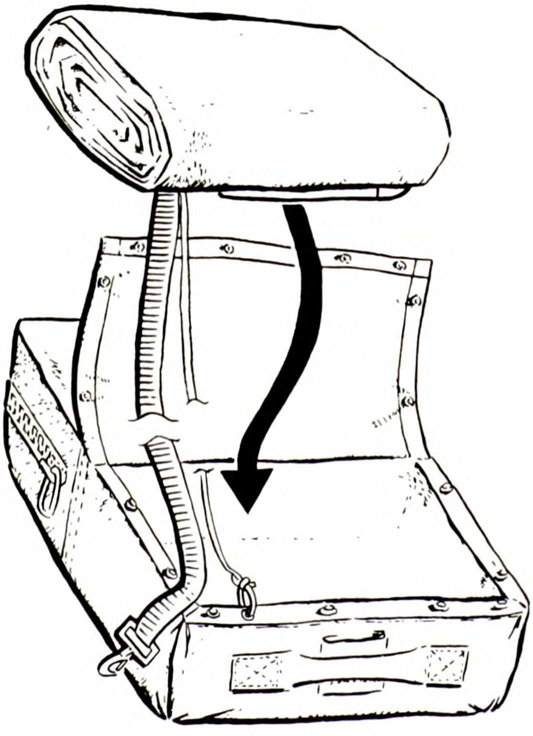


Figure 16-29.—Enclosing the pararaft in the case.

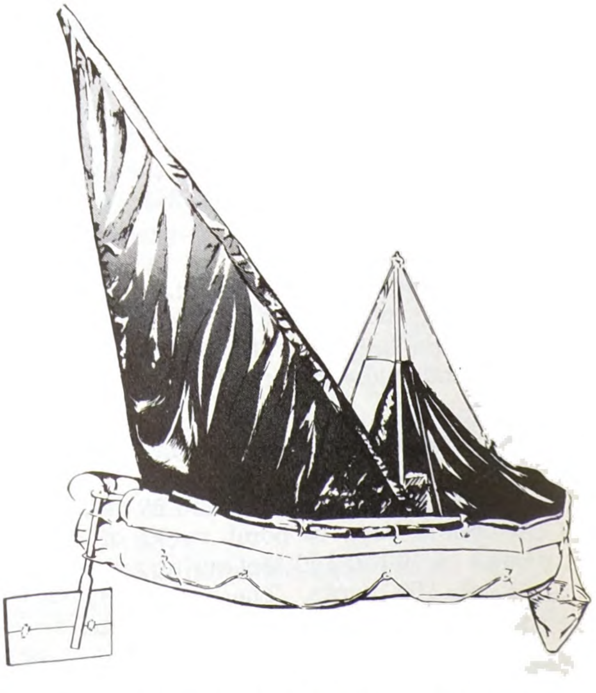


Figure 16-30.—AR-4 droppable boat.

possible to the center of the bottom during the rolling operation. The keel must be extended flat on one side. The CO_2 actuating control must be kept clear.

The boat is placed in the carrying case, folded and rolled, with the open portion up, and alined with the carrying case opening. This is to assure that the boat will float and inflate right side up on the water. After this, the case is closed as the releasing assembly is engaged.

TWELVE-MAN AND TWENTY-MAN LIFE RAFTS

The Mk 12 life raft is oval shaped, and the Mk 20 is circular shaped. Both life rafts are designed to be carried in transport type aircraft for use in emergency ditching. Both types of rafts are constructed of a lighter-weight nylon fabric than the fabric used in the construction of the Mk 4 and Mk 7 life rafts. A protective cover, similar to a paulin, is furnished with both rafts to protect the user from wind and spray. The protective cover is reversible. The outer surface is NEON RED to attract rescue craft, and the inner surface is NONSPECULAR BLUE so that the canopy may be reversed for camouflage if desired.

Mk 12 Life Raft

DESCRIPTION

The Mk 12 life raft is a double-tube raft equipped with a canopy and mattress floors. (See fig. 16-31.) The coated cloth bottoms of the raft extend across the enclosure formed by the main flotation tube. In the Mk 12, the main flotation tube is inflated initially with CO_2 and the floor and top tubes are inflated manually with the inflation pump. The Mk 12 life raft is equipped and packed in a THROW OUT type carrying case.

The following items of equipment are provided with the Mk 12 life raft:

Reflector, raft corner or Transceiver, AN/PRC-17.
Oars, life raft, 4.
Compass, magnetic.
Signals, distress, 9.
Markers, dye, 9.
Pumps, inflator, 2.
Paulin, signaling.
Bags, water storage, 12.
Kits, sea-water, solar, distillation, 12.
Kits, sea-water, desalter, 12.

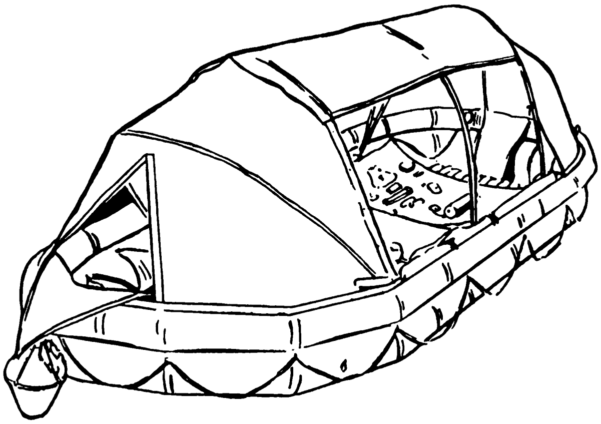


Figure 16-31.—Mk 12 life raft.

Code, emergency signaling, 2.
Sponges, cellulose, 2.
Cord, nylon, 200 feet in 50-foot lengths.
Whistles, signaling, 2.
Packets, food, survival artic individual, 12,
or Packets, food, life raft, aircraft, 12.
Kits, first aid, life raft, 2.
Ointment, sunburn, 2.
Anchor, sea.

Mk 20 Life Raft

DESCRIPTION

The Mk 20 pneumatic life raft consists of two buoyancy chambers mounted one upon the other with a floor suspended between the two chambers. Each chamber is divided into a main flotation compartment and a boarding station compartment. The life raft is identical on either side of the floor. The floor of the raft incorporates inflatable floor supports which, when inflated, are capable of holding the floor of a fully loaded raft in a horizontal position. The design of the raft is such that the raft is always right side up regardless of which side is uppermost.

The life raft is fabricated of rubber-coated nylon fabric. The flotation compartments are initially inflated with CO_2. A hand pump furnishes the necessary air for the initial inflation of the boarding stations and floor supports, and maintains the pressure in all compartments after the initial inflation. An equalizing tube is provided between the main compartments in the event the inflation system does not distribute the gas equally to the two tubes. THE EQUALIZER TUBE MUST BE OPEN WHEN THE LIFE

RAFT IS PACKED FOR USE. Topping-off valves are located in the main compartments and boarding stations so that the compartments may be inflated from either side of the life raft. The Mk 20 life raft is illustrated in figure 16-32.

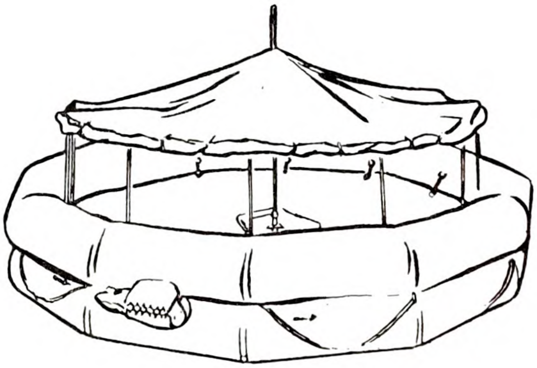


Figure 16-32.—Mk 20 life raft.

Each life raft is provided with a reversible-type canopy for protection from the elements. The canopy is supported over the raft by aluminum rods and a center support mast. For maximum protection, the bottom of the canopy is anchored around the outer perimeter of the raft between the flotation tubes, as shown in figure 16-33.

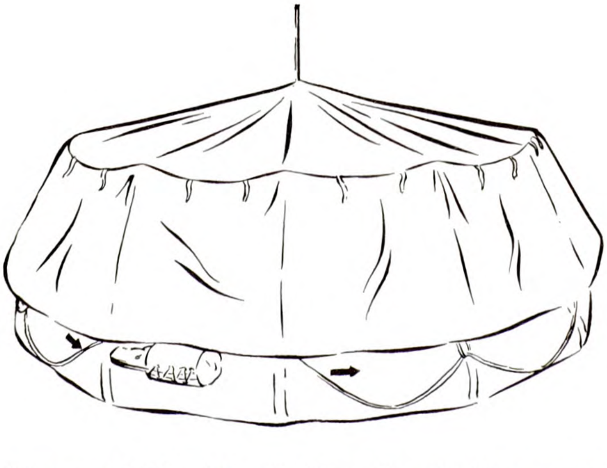


Figure 16-33.—Mk 20 life raft with the canopy anchored to the raft.

An accessory kit is located inside of the folded life raft. The kit is secured to the life raft line by a 10-foot nylon line to prevent loss of accessory equipment when the life raft is inflated. The accessory kit contains the following equipment:

Nomenclature	Quantity
Handpump, complete with hose	1
Kit, first aid	1
Kit, repair	1
Desalter kit, seawater, Mk 2	12
Desalter kit, seawater, solar	12
Signal, distress, day and night, Mk 13 Mod 0	10
Rations, survival type	20
Reflector, corner	1
Flashlight, type A-9	1
Sponge, size 8	2
Mirror, signaling, Mk-3	2
Lipstick, antichap and sunburn	6
Compass, magnetic, pocket card type	1
Bag, water storage	10
Ointment, sun protective	3
Marker, sea, fluorescein dye	12
Whistle, signaling	2
Bucket, bailing	1
Cord, nylon, 50-foot lengths	4
Clamp, sealing, 3-inch size	1
Towline	1
Canopy	1
Mast, canopy	1
Rod, canopy support	12
Anchor, sea, size II	1
Clamp, pressure equalizer	2
Line, heaving	2
Container, accessories	1
Case, carrying	1

OPERATION

To inflate a life raft packed in the carrying case, locate the end of the actuating lanyard in the end flap of the case. Grasp the lanyard firmly, toss out the raft, and jerk the cable release free of the cylinder discharge head. Hold on to the retaining line to preclude loss of the life raft. Life rafts are equipped with a throw-out-type carrying case which allows those stowed close to exist to be manually tossed out and inflated simultaneously.

Automatic inflation of a raft installed in the life raft compartment of an aircraft is accomplished by means of a control cable attached to the compartment latching mechanism and to the loop on the end of a CO_2 cylinder valve release cord. It is actuated from a handle inside the aircraft. The control cable releases the life raft compartment door latch before actuating the CO_2 cylinder valve. Actuation of the control cable should be accomplished by a sharp pull on the handle. Inflation of the life raft effects automatic ejection from the aircraft compartment.

The floor supports are inflated with air through the topping-off valves by use of the hand pump. To pump up the floor supports on the under side of the floor, attach the hose to the topping-off valve on the top side of floor. Open the valve 2 turns and pump up the supports, close valve, and remove the hose. DO NOT OVERINFLATE. One pound per square inch (p.s.i.) is the recommended pressure for floor supports.

The specified charge in the cylinder for the Mk 20 life raft inflates the raft to approximately 1.25 p.s.i. The initial pressure of the gas in the life raft may be low but will increase until ambient temperature is reached, usually in about 5 to 10 minutes. The discharge of the CO_2 gas into the life raft produces a cooling effect.

If at any time the flotation tubes appear to be too tightly inflated, the pressure may be reduced by opening the topping-off valve. As soon as the pressure is sufficiently reduced, the valve should be closed securely. If the life raft is underinflated, either initially or because of leakage, the hand pump should be attached to the topping-off valve, and each flotation tube properly inflated.

The boarding stations should be inflated to 2 p.s.i. immediately after all personnel are aboard. The boarding stations are inflated through the topping-off valve by use of the hand pump.

Special instructions for the erection of the canopy and reflector target over the life raft are stenciled in 1/2-inch letters on the floor of the life raft.

PACKING

In lieu of packing the MK 20 life raft in a carrying case for manual toss-out and inflation, the raft may be packed and installed in a compartment for ejection. This system uses no submersion switch or actuating control cylinder. It is a remote type manual system which is controlled from the cabin of the aircraft. The following steps apply to folding and installing the Mk 20 life raft for ejection:

1. Place the raft on a flat surface after it has been completely deflated. Because of the size of the raft, a large well-cleaned area of deck is the best place for packing. The position of the inflating cylinder will determine whether the raft is stowed in a left- or right-wing compartment If the cylinder is facing the wrong direction, turn the raft completely over.
2. Fold the raft in thirds so the cylinder remains at the end of the raft. (See fig. 16-34.)
3. Fold back one-half of the top fold.
4. Make 5 folds in accordion pleats so that the cylinder is resting on top of the rectangular bundle.
5. Set the life raft into the proper compartment. (See fig. 16-35.) The operating head of the raft cylinder must face inboard with the cylinder at the aft side of the compartment. Place the cylinder on the supporting rack. The accessory container may be placed in the bottom of the compartment before the raft is stowed, or on top of the folded raft.
6. Connect the release cables at the quick-disconnect fittings.
7. Connect the raft lanyard to the raft lifeline, and place the bag holding the lanyard on top of the life raft.
8. Close and latch the compartment door or cover.
9. Turn the adjusting screws on the cylinder support rack so the cylinder is held tightly against the compartment cover. Access to the adjusting screws is through the wing-flap opening.

MAINTENANCE

All personnel engaged in the handling, inspection, or maintenance of life rafts must exercise caution to avoid stepping or sitting on packed rafts or placing any weights or items on the rafts which are not required there. While accomplishing maintenance or repair of unpacked rafts, personnel must not step on any part of the raft while wearing shoes, nor step on any part of the flotation tubes. Life rafts must not be thrown around or dropped, for this may cause damage to the raft or accessories. Particular care must be exercised to prevent hydrocarbons, such as gasoline, oil, or grease from contacting raft materials.

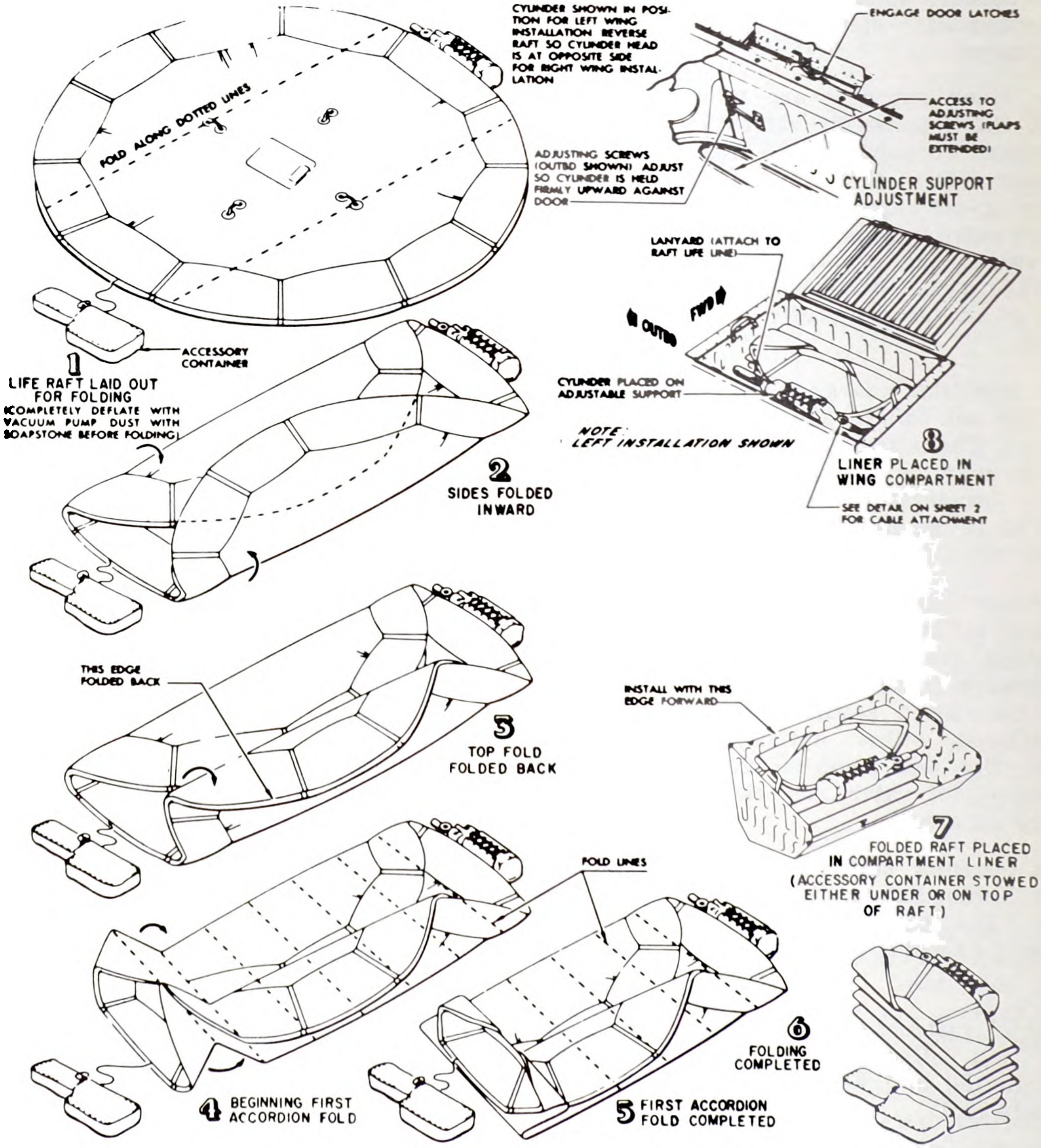

FOLD ALONG DOTTED LINES
CYLINDER SHOWN IN POSITION FOR LEFT WING INSTALLATION REVERSE RAFT SO CYLINDER HEAD IS AT OPPOSITE SIDE FOR RIGHT WING INSTALLATION
ENGAGE DOOR LATCHES
ACCESS TO ADJUSTING SCREWS (FLAPS MUST BE EXTENDED)
ADJUSTING SCREWS (OUTBD SHOWN) ADJUST SO CYLINDER IS HELD FIRMLY UPWARD AGAINST DOOR
CYLINDER SUPPORT ADJUSTMENT
ACCESSORY CONTAINER
1
LIFE RAFT LAID OUT FOR FOLDING
(COMPLETELY DEFLATE WITH VACUUM PUMP DUST WITH SOAPSTONE BEFORE FOLDING)
LANYARD (ATTACH TO RAFT LIFE LINE)
OUTBD
FWD
CYLINDER PLACED ON ADJUSTABLE SUPPORT
NOTE:
LEFT INSTALLATION SHOWN
8
LINER PLACED IN WING COMPARTMENT
SEE DETAIL ON SHEET 2 FOR CABLE ATTACHMENT
2
SIDES FOLDED INWARD
THIS EDGE FOLDED BACK
3
TOP FOLD FOLDED BACK
INSTALL WITH THIS EDGE FORWARD
7
FOLDED RAFT PLACED IN COMPARTMENT LINER
(ACCESSORY CONTAINER STOWED EITHER UNDER OR ON TOP OF RAFT)
FOLD LINES
6
FOLDING COMPLETED
4 BEGINNING FIRST ACCORDION FOLD
5 FIRST ACCORDION FOLD COMPLETED

Figure 16-34.—Packing the Mk 20 life raft for installation for ejection.

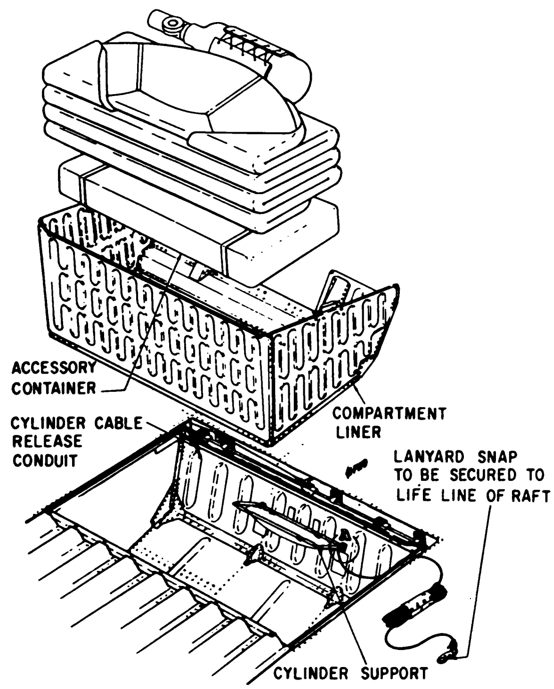

ACCESSORY CONTAINER
CYLINDER CABLE RELEASE CONDUIT
COMPARTMENT LINER
LANYARD SNAP TO BE SECURED TO LIFE LINE OF RAFT
CYLINDER SUPPORT

Figure 16-35.—Placing the folded raft into the compartment.

Before installing the Mk 20 life raft, visually inspect for abraided and scuffed areas, mildew, loosened screws and patches, wrinkles and air pockets, and deterioration of the fabric. Rafts that are slightly mildewed may be cleaned using a cloth moistened with rubber solvent (aromatic naptha).

Use this solvent sparingly to avoid loosening the rubber coating of the fabric. After cleaning the raft with solvent, apply 2 coats of light, self-curing cement to the entire raft and allow to dry for 24 hours before folding or inflating the life raft.

The following procedure applies to the repair of tears or abrasions in the surface of the flotation tubes between seams. (This does not apply to repair of the internal bulkheads or diaphragms.)

1. Lay damaged area of raft flat on worktable and determine the size of the tear. Damages less than 2 inches in length or diameter may be repaired by application of an outside patch. Damage exceeding 2 inches in length or diameter requires an inside patch as well as an outside patch.
2. Prepare the inside patch with straight sides to extend 1 1/2 inches from all extremities of the tear. Round off corners of the patch and mark crosslines 1 1/2 inches from edge of patch to properly locate the patch under the damaged area.
3. To insure that the inside surface of the raft is powdered properly in the area of the repair, place a small handful of talc through the tear approximately 12 inches from the damaged area. Care must now be taken to prevent distribution of the talc prior to completion of the repair.
4. Using a cloth moistened with solvent, clean an area of the inside surface at the tear slightly larger than the patch. Allow to dry thoroughly.
5. Apply 2 coats of extra light self-curing cement, and 3 coats of heavy self-curing cement to the cleaned area, and also to the side of the inside patch to be applied. Allow each coat to dry thoroughly before applying successive coats, with the exception of the last coat.
6. While the last coat of cement is still slightly tacky to the touch, apply the patch. To do this, fold the patch lengthwise in the shape of the letter U, and insert the patch using crosslines to coincide with extremities on one side of the tear. Working from attached edges of fabric to edge of the patch, smooth out any wrinkles with a stitcher. Butt torn edges. Remove wrinkles and roll area thoroughly with a 2-inch rubber roller.
7. Grasp sides of the flotation tube and pull apart to scatter the talc previously placed inside the tube.
8. Prepare the outside patch of proper shape and size to provide not less than 1/2 inch overlap of the inside patch in all directions. Pinking shears should be used for cutting this patch.
9. Clean and apply cement to damaged area on outside surface of the raft and patch, using the same procedures outline for the inside patch.
10. Center the patch and apply to the prepared surface using the 2-inch roller and stitcher as necessary.
11. Dust the repaired area lightly with talc and allow 5 DAYS CURING TIME.
12. Inspect and pressure test the raft in accordance with applicable publications before using.

When using an outside patch only for repair, the patch should extend 2 inches in all directions beyond the damaged area. All outside patches should be cut with pinking shears.

Emergency repair of the life raft, when in the water, is accomplished by the use of the metal clamp type plugs provided in the accessory equipment container of each life raft.

STOWAGE

Life rafts to be carried in aircraft not provided with life raft compartments, should be stowed in the fuselage in a manner and position that will make them readily available. This will save much time for personnel who are abandoning the aircraft in case of an emergency water ditching. Life raft assemblies stowed in the fuselage should retain the carrying cases. Because of the nature of materials used in life raft construction, maintenance and flying personnel should avoid sitting, dropping, or placing heavy equipment or tools on the life raft assembly. All rafts must be stowed in a clean place which is free of oil, grease, or other rubber deteriorating agents.

Aircraft provided with compartments of suitable size to accommodate a complete Mk 20 life raft assembly will have the life raft and accessory kit removed from the carrying case. This will enable proper storage in the compartment as covered in the packing section of this chapter. The stowage rope, which secures the life raft to the aircraft, has an approximate breaking strength of 170 pounds.

Pneumatic survival equipment of any kind should never be stowed near hot places, batteries, auxiliary power plants, stoves, inverters, or the like. Frequent inspection and occasional discipline will also be necessary in order to detect and stop pilferage of the contents of the stowed rafts. Nonflying squadron personnel must be made aware of the dangers which may result from pilferage.

DEMONSTRATING THE USE OF LIFE RAFTS

Many ditchings and water crashes occur in a rough sea or at night. Only complete familiarization with the use of survival equipment will give the aircrewman a chance of survival under adverse conditions. Therefore, intensive drill in the use of life rafts and their associated equipment is essential for safety.

The survival officer will be concerned with survival techniques and should see that a survival program is set up in the parachute loft. In most cases, the chief in charge of the loft will have the responsibility of setting up this training. As a PR3 or PR2, you will have many occasions to participate in this training, and in many instances may be completely responsible for the carrying out of the program. Regardless of who is in charge and must shoulder the complete responsibility, it is the duty of every Parachute Rigger to be completely familiar with all phases of survival training and be able to demonstrate the use of this equipment.

A very effective system of training in water survival techniques is the use of the Dilbert Dunker to simulate an actual aircraft ditching as closely as possible and to teach the best escape procedure with full equipment.

Although such complete courses of training cannot be conducted in certain localities because of the lack of specialized equipment, the Parachute Rigger should make every attempt to give aircrewmen frequent practice in the actual use of the equipment. Demonstrations, shop lectures, and discussions are helpful, but only working with the actual life raft equipment can result in the mastery essential for safety.

Inflating the Life Raft

In demonstrating the use of life rafts, the most important thing to stress is inflating the raft as soon as possible and getting out of the water. Inflation of the raft is effected by pulling on the short length cable attached to the CO_2 cylinder valve. After several hours, the CO_2 cylinder may be removed from the side of the raft. It tends to chafe the side of the air compartment and also acts as an anchor, causing the life raft to orbit around it. Sometimes it is possible to back off the coupling between the cylinder and the manifold so that the cylinder releases from the mount. Once the cylinder has been removed, it will no longer be useful in any way and should be thrown over the side. This of course is under actual emergency conditions; in a training demonstration, the cylinder should be saved and recharged for further use on the training equipment.

The life raft can also be inflated manually. If nothing happens after the CO_2 cable has been pulled, the carrying case should be pulled off and the raft unfolded so that the hand pump in the oar pocket will be accessible. After the pump is removed, the first compartment to be inflated should be the seat. This will help keep the raft afloat so the remaining two compartments can be inflated with the pump. These two compartments are inflated through the topping-off valves located on the side of the raft opposite the cylinder. In attaching the pump, care must be taken not to screw the pump too tightly to the valve. If it is too tight, it may freeze and be impossible to loosen without some type of wrench or pliers.

Boarding the Life Raft

The best way to board the multiplace raft is to grasp the boarding handle, kick feet vigorously while pulling elbows and life vest over the raft tube. Then grasp the inboard boarding handle, and pull and roll the body into the life raft. Another way of boarding the raft is illustrated in figure 16-36. This method is more satisfactory when boarding the PK-2 pararaft. Boarding the raft by going over the end rather than the side, lessens the possibility of capsizing the life raft.

If the life raft should capsize, it is best to approach it from the side on which the CO_2 cylinder is installed. The survivor reaches across the raft and grasps the righting handle farthest from the cylinder. Then, by sliding back into the water and pulling on the righting handle at the same time, the raft will turn right side up. By this method, there will be no chance of the CO_2 cylinder hitting the survivor when he rights the raft.

Another important point to remember in righting the raft is to note the surface winds and take advantage of them. It is very hard to right a life raft against the wind.

Safety Precautions in Boarding Life Rafts

Extreme care should be taken when boarding rafts or assisting personnel into the raft from the water. This is particularly so if such persons are wearing parachute harness or life vests. Once in the raft, all personnel should seat themselves on the floor and remain in position if at all possible. Movement within the raft should be restricted as much as possible to keep friction at a minimum. All sharp objects should be collected and stored, especially jeweled rings, wrist watches, etc. All loose articles of equipment should be properly packaged to protect the life raft fabric.

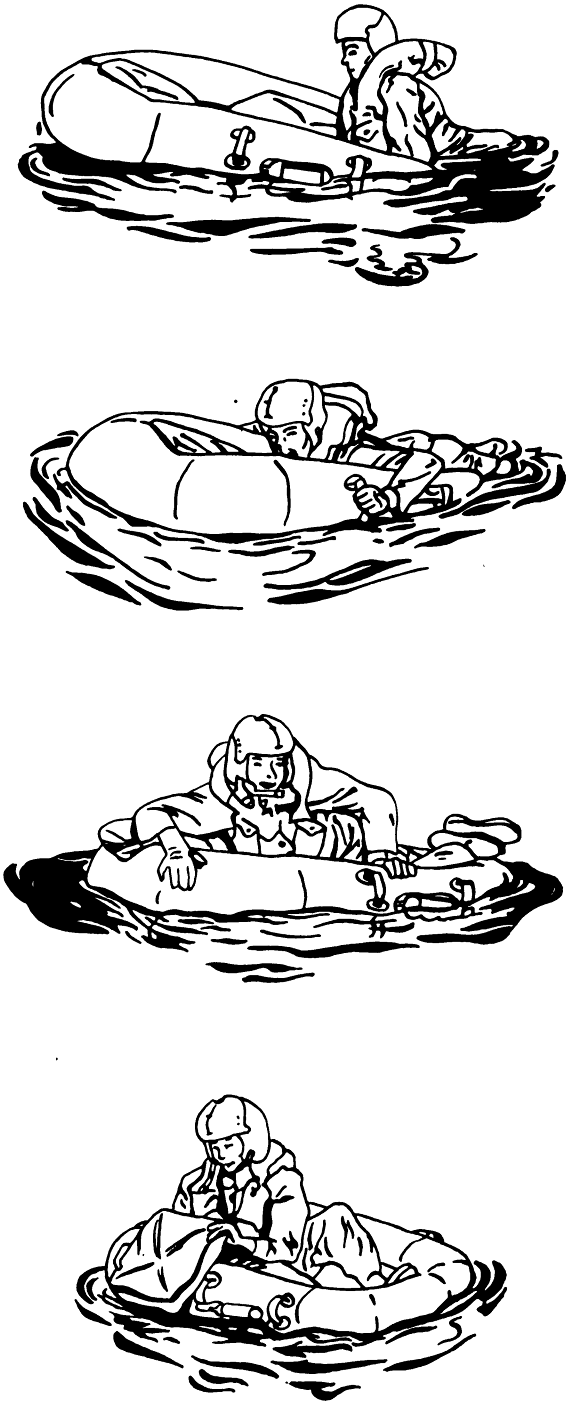


Figure 16-36.—Boarding the life raft.

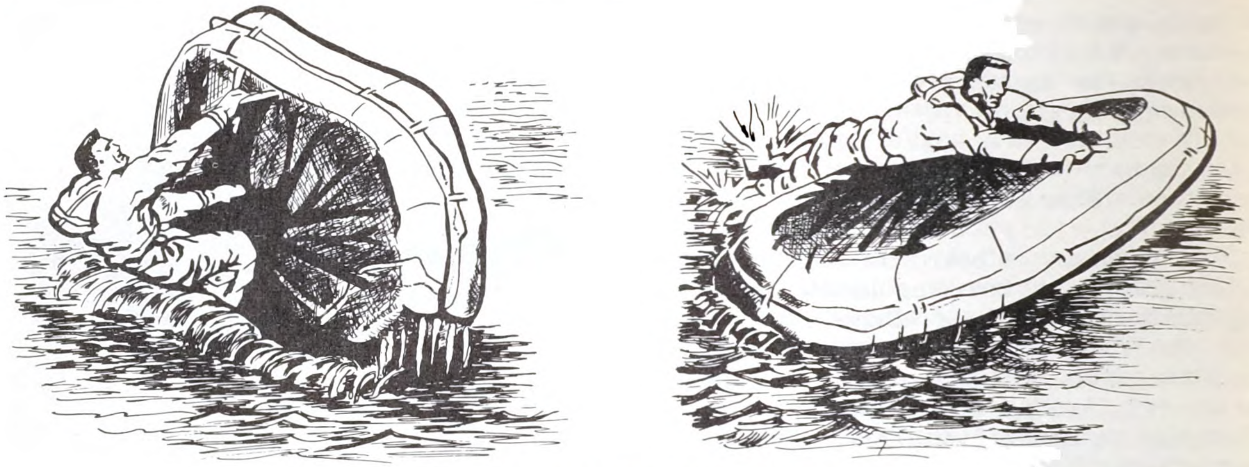


Figure 16-37.—Righting a capsized life raft.

QUIZ

1. When patching life rafts, each surface to be joined receives a total of_____coats of cement.
    - a. 2
    - b. 3
    - c. 4
    - d. 7
2. One of the disadvantages of the solar still is that it
    - a. produces more water than needed
    - b. does not remove enough salt from the water
    - c. fails to operate effectively in cold weather
    - d. is almost impossible to keep inflated
3. The AR-4 lifeboat has
    - a. an inflatable floor
    - b. a rudder and keel
    - c. a spray tube
    - d. all of the above
4. The primary purpose of the webbing loops attached to the flotation tube of the Mk 7 life raft are for rigging the
    - a. paulin
    - b. poncho
    - c. hammock
    - d. sail
5. The patch of rubberized material for repairing a multiplace raft conforms to specification
    - a. F-28, type H
    - b. F-28, type C
    - c. AN-F-10, type H
    - d. AN-F-10, type C
6. In Mk 4 life rafts, the day and night signals Mk 13 Mod 0, are stored in the
    - a. bailer pocket
    - b. oar pocket
    - c. emergency equipment container
    - d. supply pocket
7. Emergency rations in the Mk 7 life raft are located in the
    - a. bailer pocket
    - b. oar pocket
    - c. emergency equipment container
    - d. supply pocket
8. In Mk 4 life rafts, the Ground/Air Emergency Code is located in the
    - a. bailer pocket
    - b. oar pocket
    - c. emergency equipment container
    - d. supply pocket
9. The sea anchor on a Mk 7 raft is always attached to the
    - a. port side
    - b. starboard side
    - c. bow
    - d. stern
10. The Mk 13 Mod 0 flare has a burning time of
    - a. 18-20 seconds
    - b. 20-40 seconds
    - c. 40-60 seconds
    - d. 60-90 seconds
11. When replacing a life line on multiplace life rafts, the allowable slack between anchor points is
    - a. 1 inch
    - b. 2 inches
    - c. 3 inches
    - d. 4 inches
12. Mk 2, 4, and 7 life rafts are known as
    - a. type S
    - b. type D
    - c. type M
    - d. type R

13. The proper CO_2 charge for a Mk 4 life raft cylinder is
    - a. 0.50 pound
    - b. 1.80 pound
    - c. 3.25 pounds
    - d. 4.70 pounds
14. The proper CO_2 charge for a Mk 2 life raft cylinder is
    - a. 0.50 pound
    - b. 1.80 pound
    - c. 3.25 pounds
    - d. 4.70 pounds
15. The proper CO_2 charge for a Mk 7 life raft cylinder is
    - a. 0.50 pound
    - b. 1.80 pound
    - c. 3.25 pounds
    - d. 4.70 pounds
16. The seat on the Mk 4 and Mk 7 life raft
    - a. inflates automatically after both compartments are inflated
    - b. is a flap type seat
    - c. is inflated by a hand pump
    - d. is constructed of neoprene coated nylon
17. The total weight of the Mk 7 life raft, fully packed and equipped for service is _____ pounds.
    - a. 50
    - b. 62
    - c. 86
    - d. 114
18. The maximum rated load capacity of a Mk 7 life raft is_____pounds.
    - a. 1,800
    - b. 2,200
    - c. 2,500
    - d. 3,000
19. Pararafts must be surveyed if they fail to pass the pressure check test and are _____ years old.
    - a. 4
    - b. 5
    - c. 6
    - d. 7
20. The proper width of the folded Mk 20 raft is_____inches.
    - a. 18-20
    - b. 28-32
    - c. 34-36
    - d. 40-44
21. When preparing to roll the Mk 20 life raft, the equipment container should be positioned
    - a. amidships
    - b. placed next to the CO_2 cylinder
    - c. at the end of the raft, opposite the CO_2 cylinder
    - d. directly between the U roll
22. When deflating a Mk 20 raft, first deflate the
    - a. mast support
    - b. upper main flotation tube
    - c. boarding stations
    - d. lower main flotation tube
23. When cutting a life raft patch, the edges should always be
    - a. beveled
    - b. straight
    - c. pinked
    - d. squared

CHAPTER 17

RECHARGING CARBON DIOXIDE CYLINDERS

Carbon dioxide gas was first discovered by J. B. Van Helmont (1577-1644), but it was not until a century later that A. L. Lavoisier (1743-94) demonstrated its nature by burning carbon in oxygen. Carbon dioxide is a component of the atmosphere. It is formed in the process of respiration, in combustion of all carbonaceous material, and in fermentation.

CO_2 (the chemical symbol for carbon dioxide) is a colorless gas, possessing a faint pungent odor and a slightly acid taste. It does not burn and does not ordinarily support combustion. However, metals such as magnesium, when ignited, will continue to burn in it while giving off oxides and liberating carbon. CO_2 gas is 1.53 times heavier than air and requires only a pressure of 600 p.s.i. below 88°F. to liquefy. It can be condensed into a colorless liquid and stored in this state under pressure in cylinders. When the cylinder valve is opened, gaseous CO_2 escapes and, because of the rapid drop in pressure and temperature, forms carbon dioxide snow. This snow, when compressed into blocks or cubes, is what we know as dry ice. Dry ice, in solid form and at atmospheric pressure (14.7 p.s.i.), evaporates, remaining at -110°F. until it disappears. It is excellent for specialized refrigeration uses.

There are many natural carbon dioxide wells in the earth's surface. Yellowstone National Park has several of these wells. In some caves the CO_2 is so dense that animals are suffocated when they wander into them. Since CO_2, in addition to being heavier than air, is both invisible and odorless, it presents a particular hazard. As in caves, it will tend to collect in low, unventilated places, such as below decks aboard ship. Men encountering these conditions run the risk of smothering to death. Small percentages of carbon dioxide will cause tiredness and perhaps headaches. Experiments have shown that a 3 percent concentration of CO_2 in the air will double the breathing effort, 5 percent will cause panting, 8 percent will cause marked distress, and 10 percent will cause unconsciousness very quickly.

Treatment of exposed personnel includes removal from the CO_2 laden atmosphere, artificial resuscitation, administering oxygen, and keeping the patient warm.

The Parachute Rigger's association with carbon dioxide is mainly in the recharging of cylinders used in the inflation of life rafts and life vests and those used in aircraft fire extinguishing systems. The servicing of CO_2 fire fighting equipment commonly used at shore establishments and aboard ship is not generally considered a part of the PR's duties.

Carbon dioxide is ordinarily procured from local commercial sources. In some locations the Navy manufactures its own. It is purchased or accounted for by the pound, since it is measured in a liquid state. Gas not in a liquid state is measured on a volume basis and purchased by the cubic foot.

Standard supply cylinders are designed to contain 50 pounds of carbon dioxide and are procured through normal supply procedures. As an example, an order for 300 pounds of CO_2 would indicate a request for 6 supply cylinders.

Carbon dioxide is listed in Group 68 in the Navy Stock List of General Stores.

CO_2 Recharge Equipment

Carbon dioxide recharge equipment is manufactured for the Navy by several different companies. The two most widely used units are manufactured by the C-O-TWO Company of Newark, New Jersey, and Walter Kidde Company of Belleville, New Jersey.

A typical recharge unit is shown in figure 17-1 and consists of a supply cylinder containing

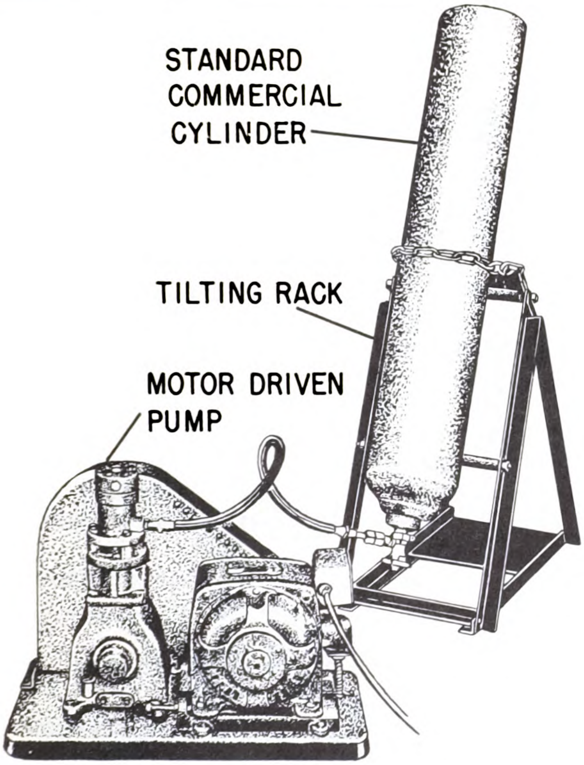


Figure 17-1.—C-O-TWO transfer unit.

50 pounds of CO_2, a tilting rack for inverting the supply cylinder, a motor-driven pump, a rack for inverting the cylinder being recharged, a scale for determining the weight of the cylinder being recharged, and the necessary high-pressure hoses, control valves, adapters, etc., to properly hook up the equipment.

Before learning the operation of any specific type of recharge equipment, you should be familiar with the following general information, which applies to all units.

Carbon dioxide recharge equipment will pump CO_2 in its liquid phase only, and the amount of liquid CO_2 a cylinder contains will vary with the temperature and pressure. For example, a standard 50-pound supply cylinder contains approximately 38 pounds of liquid CO_2 and 12 pounds of gaseous CO_2 at a temperature of 70°F. It follows, then, that the cooler the supply cylinder and cylinder being recharged, the more efficient the operation of the transfer equipment. For the same reason, the time required to recharge an empty cylinder increases with the temperature of the cylinders.

When recharging a cylinder, if the cylinder being recharged is inverted during the process, it will remain cooler and will be filled faster than if placed in an upright position. Larger size cylinders which are impractical to invert should be placed horizontally on the scale.

Standard commerical supply cylinders in 50-pound sizes are obtainable with or without a syphon tube. When transferring from a cylinder without a syphon tube, the cylinder must be inverted. Supply cylinders with syphon tubes should be maintained in an upright position, not more than 60 degrees from vertical.

After all the liquid CO_2 has been transferred from a supply cylinder (approximately 80 percent of the net contents), the efficient transfer of CO_2 will cease. Then, a new fully charged supply cylinder must be used to finish charging a cylinder to its fully rated capacity. The major part of the CO_2 in the other supply cylinder can be used when recharging another empty cylinder, as the CO_2 will transfer itself under its own pressure until the pressure in both cylinders is equal. In this manner, the most economical use of the supply cylinder contents is made.

C-O-TWO TRANSFER UNIT

A typical C-O-TWO transfer unit is illustrated in figure 17-1. The general procedure for its operation is described in the following paragraphs. For more complete details on erection, operation, and maintenance of the unit, reference should be made to NavAer 19-1-516.

General Operating Instructions

1. Connect the pump inlet hose to the supply cylinder outlet.
2. Connect the pump outlet hose to the recharging adapter on the cylinder to be recharged. The pump outlet valve is fitted with a shutoff valve.
3. Check all connections and make certain that they are properly and securely made up. This is very important. When making up connections, use a 12-inch wrench with a slow, steady pull. Do not jerk or hit the wrench with a hammer.
4. Make certain that the shutoff valve in the pump outlet hose is in the tightly closed position and that the valve of the cylinder being recharged is in the open position.
5. Fully open the valve of the supply cylinder.
6. Place the empty cylinder on the scale.
7. Carefully determine the net capacity and total weight of the cylinder to be recharged and set the scale to equal the fully charged weight

shown on the side of the cylinder valve, the cylinder, or the nameplate band.

8. Open the shutoff valve in the pump outlet hose and allow the CO_2 in the supply cylinder to transfer over to the cylinder being recharged under its own pressure.

9. After the CO_2 has stopped flowing into the cylinder being recharged under its own pressure (the weight of the cylinder being recharged will stop increasing), start the transfer unit and watch the scale carefully.

10. When the full capacity of the cylinder being recharged has been reached, perform the following operations in rapid succession:
   a. Stop the transfer unit motor.
   b. Tightly close the shutoff valve in the pump outlet hose.
   c. Close the valve of the cylinder being recharged.

CAUTION: Do not close the cylinder valve or the shutoff valve while the transfer unit is pumping.

11. Disconnect the hose from the cylinder being recharged. Do this very slowly so as to allow the pressure trapped between the shutoff valve and the cylinder being recharged to escape. Remove the adapter.

12. Weigh the recharged cylinder carefully.

13. After recharging is complete, close the supply cylinder valve tightly and open the shutoff valve in the pump outlet hose very slowly, allowing all the gas in the pump to discharge to atmosphere.

NOTE: This transfer unit is to be used for carbon dioxide only. Do not use for oxygen or other gases.

WALTER KIDDE RECHARGE UNIT

Another widely used CO_2 recharge outfit is the Walter Kidde unit (fig. 17-2). This unit is supplied complete with the necessary adapters, valves, safety discs and bushings, nuts, bolts, and washers for making connections to the cylinder to be recharged, connections to the supply cylinder, and tools for making minor adjustments to the unit. The motor is equipped with a safety switch.

The following operating instructions are general in nature. For detailed instructions on recharging specific types of cylinders, reference should be made to NavAer 19-1-501.

General Operating Instructions

1. Connect strainer adapter to the supply cylinder outlet, then make up coupling adapter nut (part No. 6071) securely. Make up coupling nut (18150) to the recharging adapter, using washer (6139) between these items. (See fig. 17-3.)

2. Be sure that the cylinder valve is open and ready for charging.

3. Place the cylinder to be recharged on the scale and note reading.

4. Open shutoff valve (24650) fully; make certain blowoff valve (24650) is fully closed. Start the recharge pump.

5. Open the supply cylinder valve fully, keeping constant check on the weight of the cylinder being recharged.

6. When the cylinder is charged with the proper weight of CO_2, stop the pump and close the shutoff valve securely.

7. Close the valve on the cylinder being recharged, then open blowoff valve.

8. Check the final weight of charged cylinder.

9. Close the supply cylinder valve securely. Relieve the pressure in the recharging pump and connections by opening the shutoff valve.

CO_2 SUPPLY CYLINDERS

Figure 17-4 illustrates the standard supply cylinder used universally in recharging various types of CO_2 cylinders. A cutaway view of the cylinder valve is also shown. Table 17-1 lists some of the most pertinent data concerning supply cylinders.

Cylinder Valves

Navy standard valves are of two basic designs: Packed valves and diaphragm type packless valves. CO_2 handwheel type valves employ the second type design.

Packed valves require a packing material around the valve stem to prevent leakage, whereas valves (used mainly in high-pressure cylinders) are sealed against leakage around the valve stem by flexible metallic diaphragms securely clamped to the valve bonnets.

The basic packless design may be classified into two types: (1) the NON-BACK-SEATING

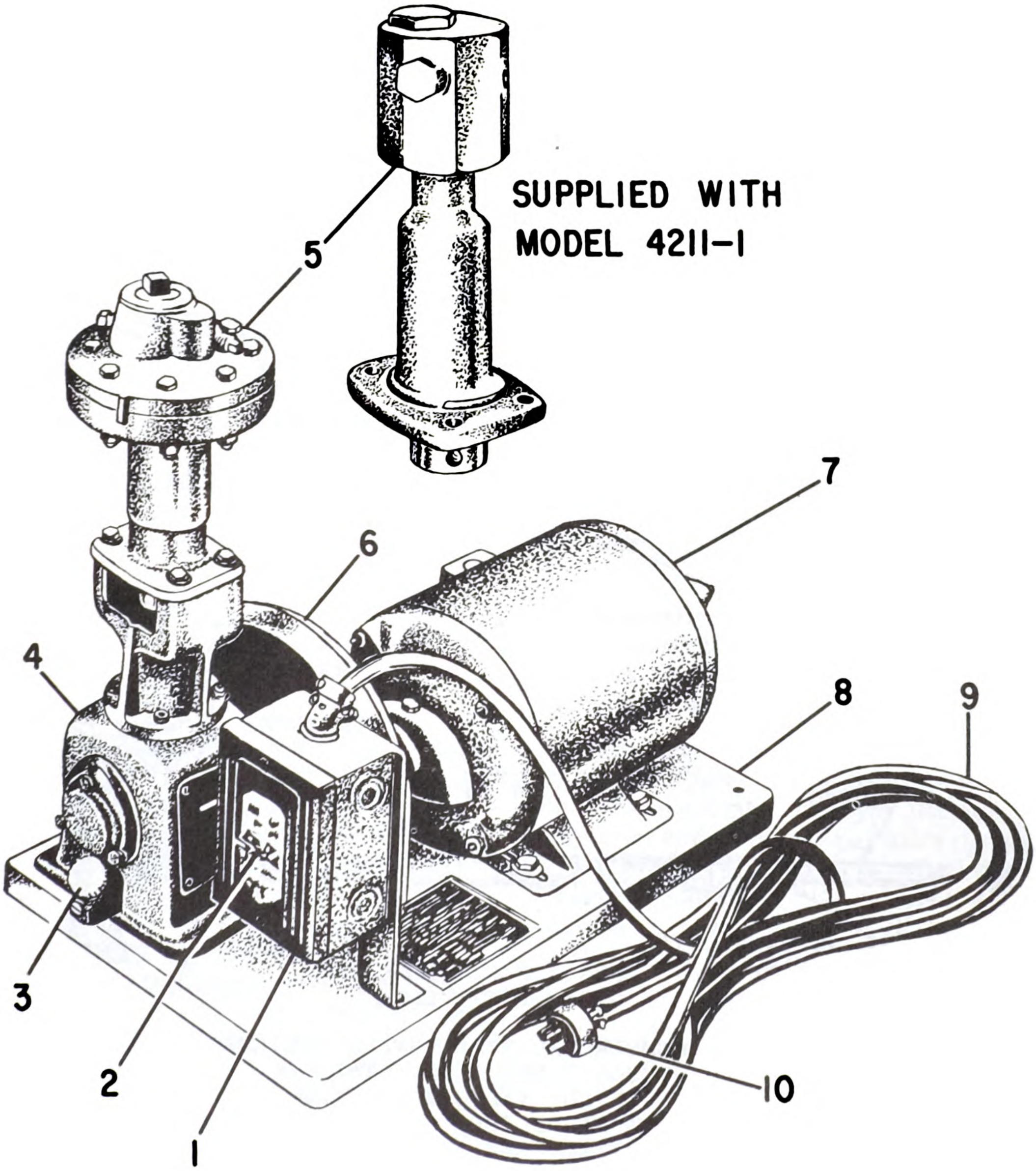
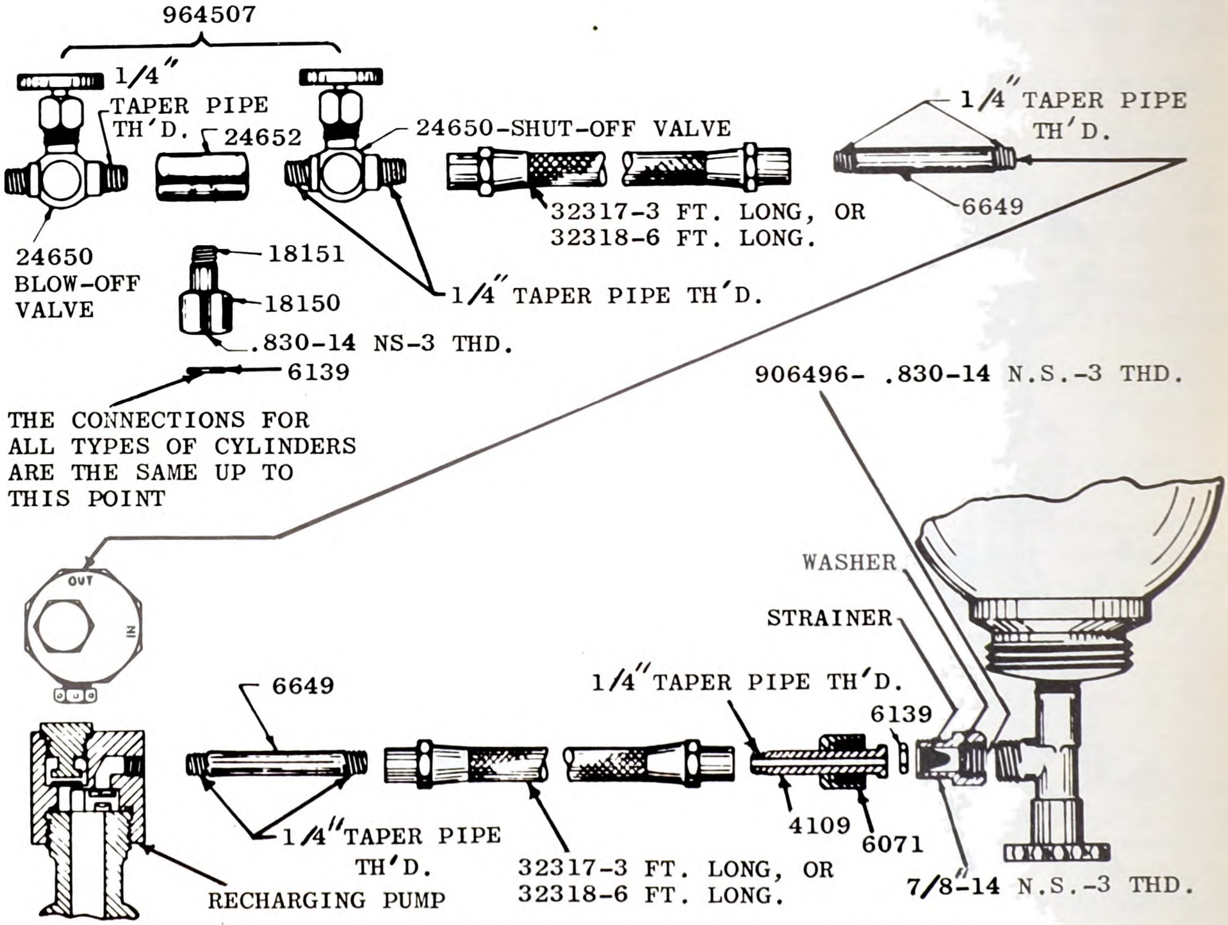


Figure 17-2.—Walter Kidde recharge unit.

1. Multibreaker.
2. Power switch.
3. Oil filler cap.
4. Running gear assembly.
5. Compressor assembly.
6. Gear guard.
7. Motor.
8. Base
9. Power cable
10. Three-prong plug.



COMMERCIAL TYPE SUPPLY CYLINDER SHOWN (NO SYPHON TUBE). THIS TYPE CYLINDER MUST BE INVERTED, VALVE AT BOTTOM.
WHEN KIDDE SUPPLY CYLINDER (FITTED WITH SYPHON TUBE) IS USED, KEEP ERECT, VALVE AT TOP.
FOR BEST RESULTS KEEP SUPPLY CYLINDER COOL.
SEE RECHARGING INSTRUCTIONS.

Figure 17-3.—Basic connections for Walter Kidde unit.

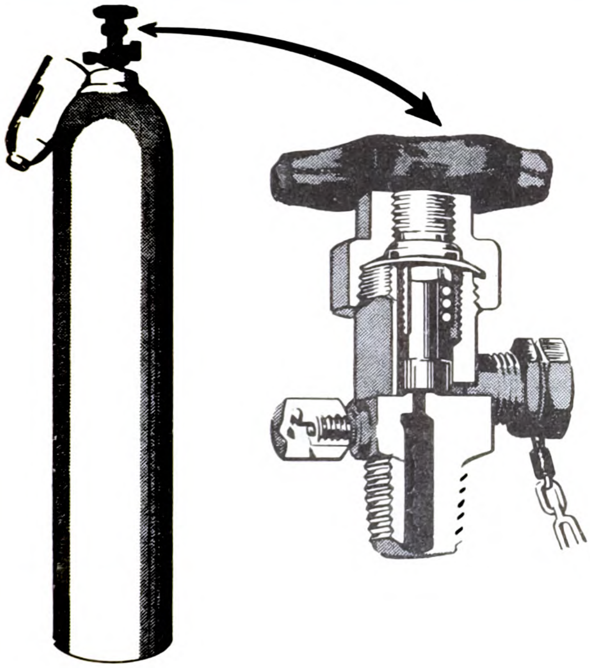


Figure 17-4.—CO_2 supply cylinder.

type, which are designed so that the metallic sealing diaphragms may NOT be replaced UNDER PRESSURE, and (2) the BACK-SEATING type, in which the metallic diaphragms may be replaced without undue hazard or loss of contained gases, provided the outlet cap is in place and secure. Replacement of diaphragms in packless valves should be done only by activities carrying spare diaphragms specifically designed for the valves in need of reconditioning. Diaphragms are fabricated from materials selected for service at high pressure while dynamically loaded. In addition, they are often of a design suitable only for use with valves fabricated by a given manufacturer and for a specific gas.

One of the features of the Navy gas valve program (and of civilian agencies) is to provide noninterchangeable valve outlets and connections for different gases to prevent using the wrong gas at any time

Table 17-1.--Supply cylinder data.

Capacity at normal pressure and temperature*.	50 pounds
Working pressure	1,800 to 2,015 p.s.i.
ICC specification	ICC3A
Dimensions (approx.)	Diameter, 8 1/2 inches; length, 51 inches
Weight, empty	110 - 115 pounds
Outlet connection	3/4 inch

*Temperature of 68° - 70°F. and atmospheric pressure.

LEAKING VALVES

Generally, cylinders with leaking or defective valves must be turned in to supply for overhaul. This is especially true in the case of stripped threads or bent stems.

Leakage is sometimes caused by the presence of dirt or other foreign particles in the valve or on the valve seat. This type leakage may sometimes be corrected by partially opening and then closing the valve to blow out the material. If leakage continues, the cylinder should be removed to a safe place in the open, if possible, and emptied by opening the valve.

Safety Devices

Safety devices for CO_2 cylinder valves consist of an unbacked safety cap with a rupture disc. It consists essentially of a safety cap covering a safety port in the valve. The cap retains a frangible disc firmly over the safety port. Under excessive pressures ranging from 2,700 to 3,000 p.s.i., the safety disc ruptures and allows the gas in the cylinder to vent to atmosphere.

Life Raft Inflation Equipment

Figures 17-5 through 17-11 illustrate various types of life raft inflation equipment items. These items consist of various sizes of cylinders and discharge heads and valves.

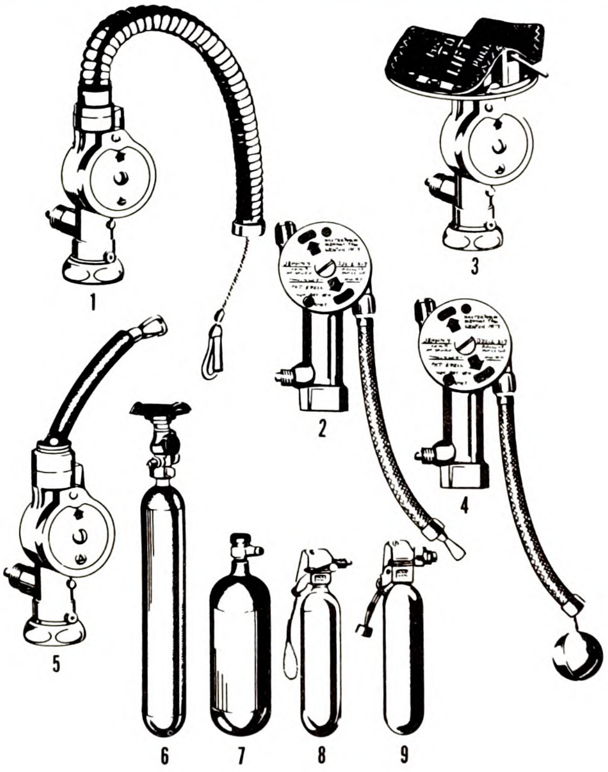


Figure 17-5.—Raft inflation equipment.

1-5. Discharge head assemblies.
6, 8, 9. Cylinder and valve assemblies.
7. Cylinder and disc body assembly.

DISCHARGE HEADS

Two types of discharge heads are commonly used. These are the cutter type and seat type. A description of the operating principles of each type follows.

Cutter Type

Pulling a cable releases the cutter which is under spring action. The cutter pierces a sealing disc in the neck of the cylinder. CO_2 discharges through the ruptured disc, bypassing the cutter and passes on through the outlet into the raft inflation compartment. A new disc must be installed in the cylinder adapter after each use. This necessity constitutes the temporary removal of the head or bonnet during the recharging process.

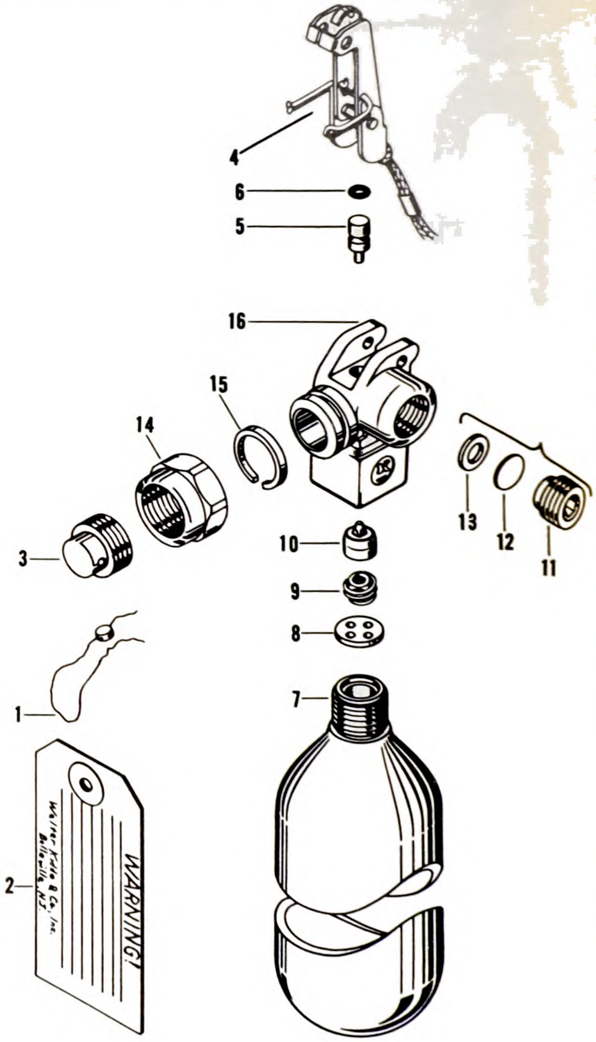


Figure 17-6.—Cylinder and valve assemblies used on the pararaft.

1. Wire seal.
2. Warning tag.
3. Recoil plug. NOTE: In some instances, under approval, this fitting is eliminated to conserve expense and weight.
4. Handle and pull cord assembly
5. Plunger.
6. O-ring hydraulic packing.
7. Cylinder, 20.4 cu. in. capacity.
8. Bottle washer.
9. Check spring.
10. Check.
11. Safety disc plug.
12. Safety disc.
13. Safety disc washer.
14. Coupling nut.
15. Brass wire.
16. Valve body.

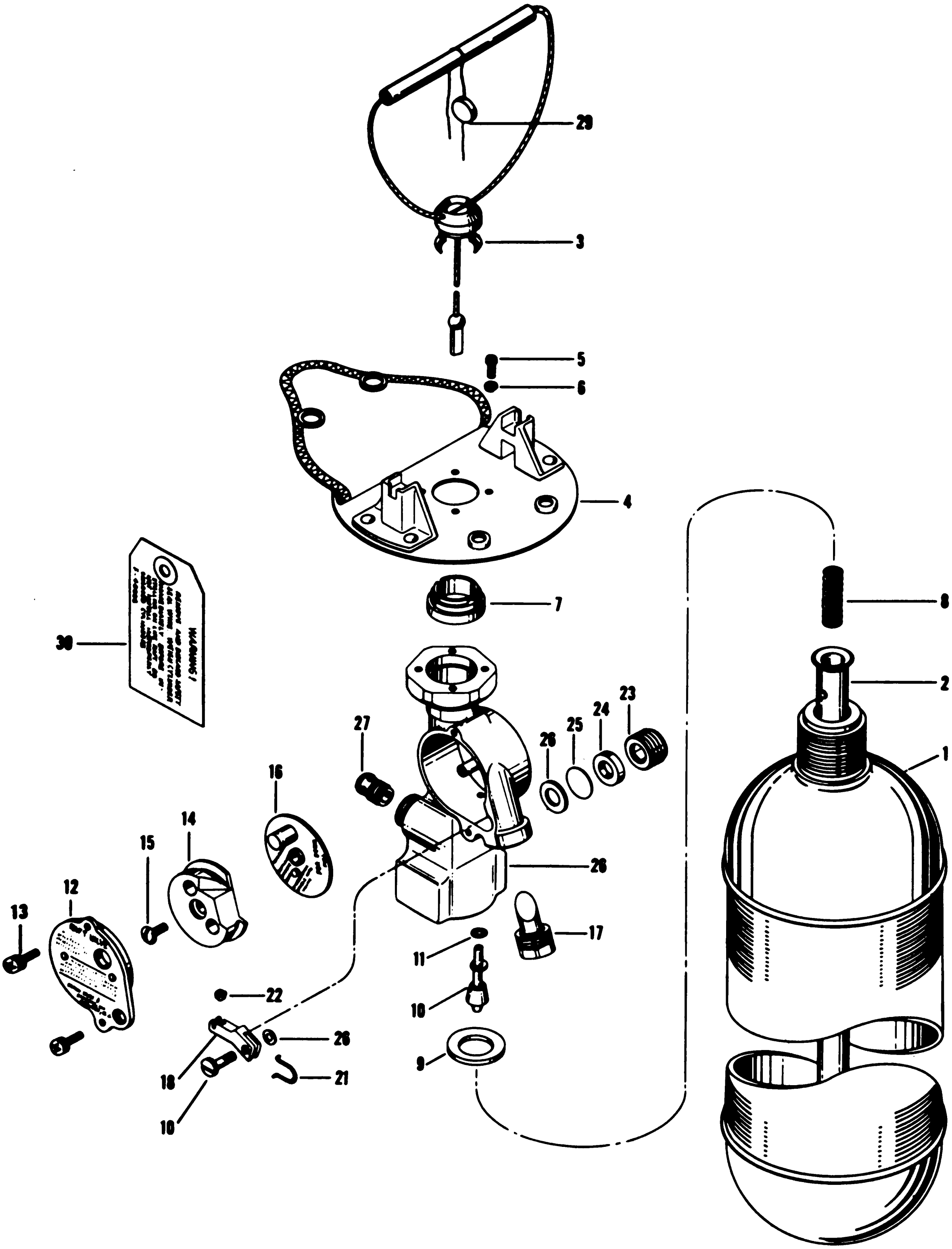


Figure 17-7.—Cylinder and valve assemblies used on multiplace life rafts. (Note that valve does not employ a cutter.)

Nomenclature for Figure 17-7.

1. Cylinder. Nonshatterable, 96 cu. in., 147 cu. in., or 205 cu. in.
2. Syphon tube.
4. Guard flap and plate.
5. Screw.
6. Washer.
7. Retainer.
8. Spring.
9. Gasket.
10. Stem.
11. O-ring packing.
12. Cover.
13. Screw.
14. Sheave.
15. Screw.
16. Camplate.
17. Plug.
18. Lever.
19. Stud.
20. Washer.
21. Lever spring.
22. Roller.
23. Retainer.
24. Plug.
25. Safety disc.
26. Safety disc washer.
27. Recoil adapter.
28. Valve body.
29. Wire seal.
30. Tag.

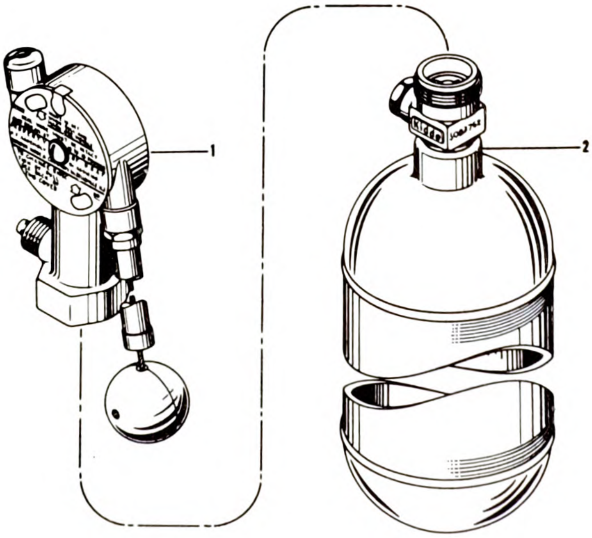


Figure 17-8.—Cylinder, disc body, and discharge head assemblies used on multiplace life rafts.

1. Discharge head assembly (seat type). (See fig. 17-9.)
2. Cylinder and disc body assemblies. (See fig. 17-10.)

Seat Type

Pulling a cable turns a cam or sheave which actuates a stem and opens a seat, thereby admitting CO_2 into the raft compartment through the outlet of the discharge head. It is not necessary to remove the discharge head for recharging after each use. A disc is not employed.

CYLINDERS

The cylinders used in conjunction with emergency equipment, designed for use in aircraft, must be shatterproof. Shatterproof cylinders are identified by a 2-inch white stripe painted on their sides. The shatterproofing is accomplished by either a heat-treating process or by a wire wrapping which encompasses the body of the cylinder throughout most of its length. Nonshatterproof CO_2 cylinders, such as some older type supply cylinders, do not carry the distinguishing white stripe. Only shatterproof CO_2 cylinders should be used in aircraft systems and related equipment.

All life raft cylinders are equipped with a syphon tube. The syphon tube may be the straight type or flexible type, depending on how the cylinder is to be mounted. Figure 17-12 illustrates both types of syphon tubes.

Cylinders equipped with flexible syphon tubes are marked with a black stripe; those having a straight type are marked by a spot, as shown in figure 17-12.

All CO_2 cylinders used in connection with aircraft fire extinguishing equipment (both portable and built-in types) must be serviced to operate throughout the temperature range of -65°F. to -150°F. This is accomplished by the addition of 200 p.s.i. of dry, oil-free nitrogen to each cylinder and then adding the proper charge of carbon dioxide. Cylinders charged in this manner are referred to as winterized cylinders.

Cylinders which are to be winterized are identified by a yellow dot 3/4 inch in diameter, or larger, on opposite sides of the cylinder.

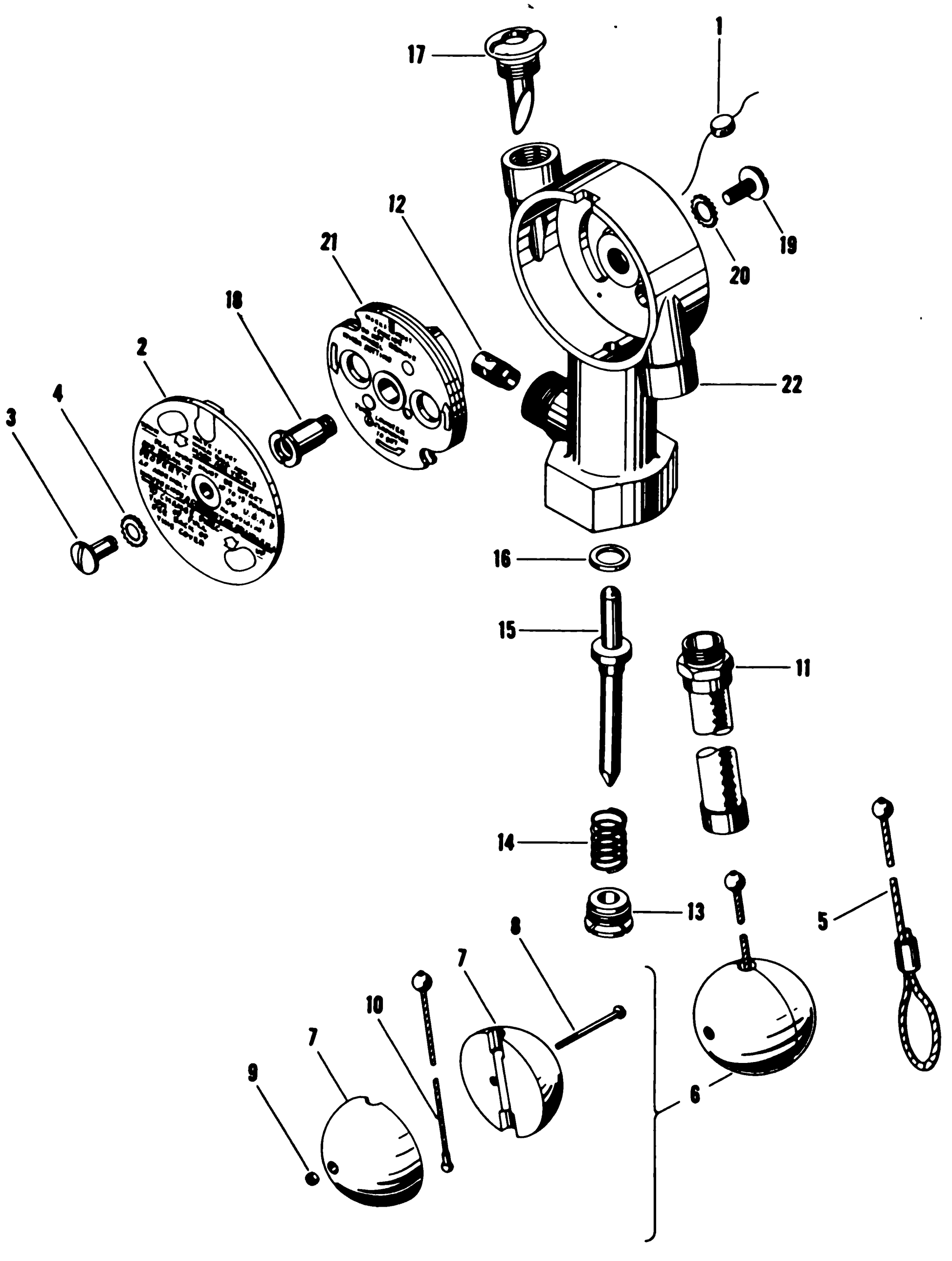


Figure 17-9.—Discharge head assemblies employing cutter type action.

1. Wire seal, copper and lead.
2. Cover.
3. Screw.
4. Washer.
5. Cable.
6. Ball and cable assembly.
7. Half-ball.
8. Screw.
9. Brass hex nut.
10. Cable.
11. Cable housing.
12. Nonrecoil outlet.
13. Retainer.
14. Spring
15. Cutter.
16. Washer.
17. Swivel plug.
18. Stud.
19. Screw.
20. External teeth type lockwasher.
21. Sheave and cam.
22. Discharge head body.

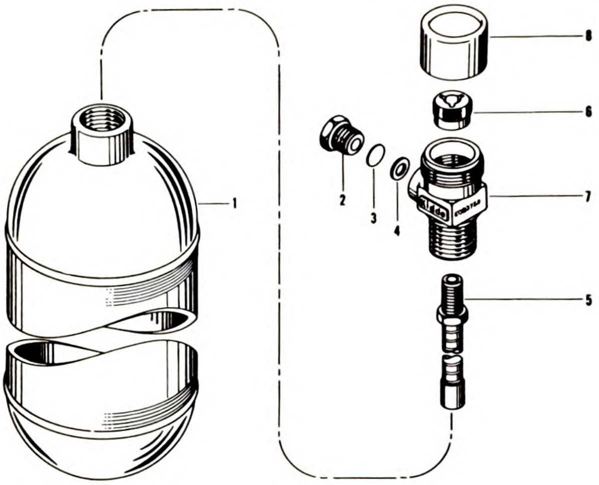


Figure 17-10.—Cylinder and disc body assemblies adaptable to bushing discs and cutter type discharge heads.

1. Cylinder (number 1 in the figure represents five sizes, each one capable of containing a specified CO_2 charge as follows: 1.80 lbs., 2.05 lbs., 3.25 lbs., 4.70 lbs., and 9.40 lbs. When the 3.25-lb. size cylinder is winterized with nitrogen, it contains a lesser charge—2.98 lbs., and when the 4.70-lb. size cylinder is winterized it contains 4.32 lbs.)
2. Safety disc retainer.
3. Safety disc (two different capacities).
4. Safety disc washer.
5. Syphon tube (four different sizes).
6. Disc bushing, red or black, depending on capacity.
7. Body (three different sizes).
8. Shipping cap.

The addition of nitrogen in CO_2 cylinders provides additional pressure which expels the CO_2 at extremely low temperatures at a much higher rate than would the pressure of the CO_2 itself.

Cylinder Maintenance

RULES FOR CLEANING AND PAINTING CYLINDERS

Cylinders should never be painted colors other than those indicated in the color code for compressed gas cylinders in Military Standard MIL-STD-101. When camouflage is necessary, canvas or other materials painted with camouflage colors may be placed over the cylinders.

Cylinders should never be painted on their interior surfaces.

Valves must be kept free from paint. Navy and Interstate Commerce Commission serial numbers and test markings must not be obliterated.

Before painting cylinders, all loose paint, scale, rust, and dirt must be removed. When spark-producing tools such as wire brushes or metallic scrapers are used, the cleaning operation should be done in the open or in a well-ventilated compartment with firefighting equipment available.

Before any cleaning operation, the valves, safety devices, and fusible plugs should be tested for leaks. Leaking cylinders should not be cleaned, but should be returned to an authorized repair activity.

TESTING CYLINDERS

Interstate Commerce Commission regulations require quinquennial (5-year) retesting of all CO_2 cylinders. Cylinders for which prescribed retests have become due must not be recharged until retests have been properly made. Cylinders which have been charged prior to the expiration of their retest period may be shipped and used until empty before being retested.

The 5-year hydrostatic tests are performed by naval and civilian establishments under regulations of the Interstate Commerce Commission, and specially approved testing equipment is required. Since ships are not authorized to conduct such tests, empty cylinders with expired test periods should be returned to the nearest naval supply point or cylinder testing activity marked "for retest."

REPAIRS

Cylinders are repaired only by activities which are specifically authorized to perform such work. To assure that all cylinders aboard

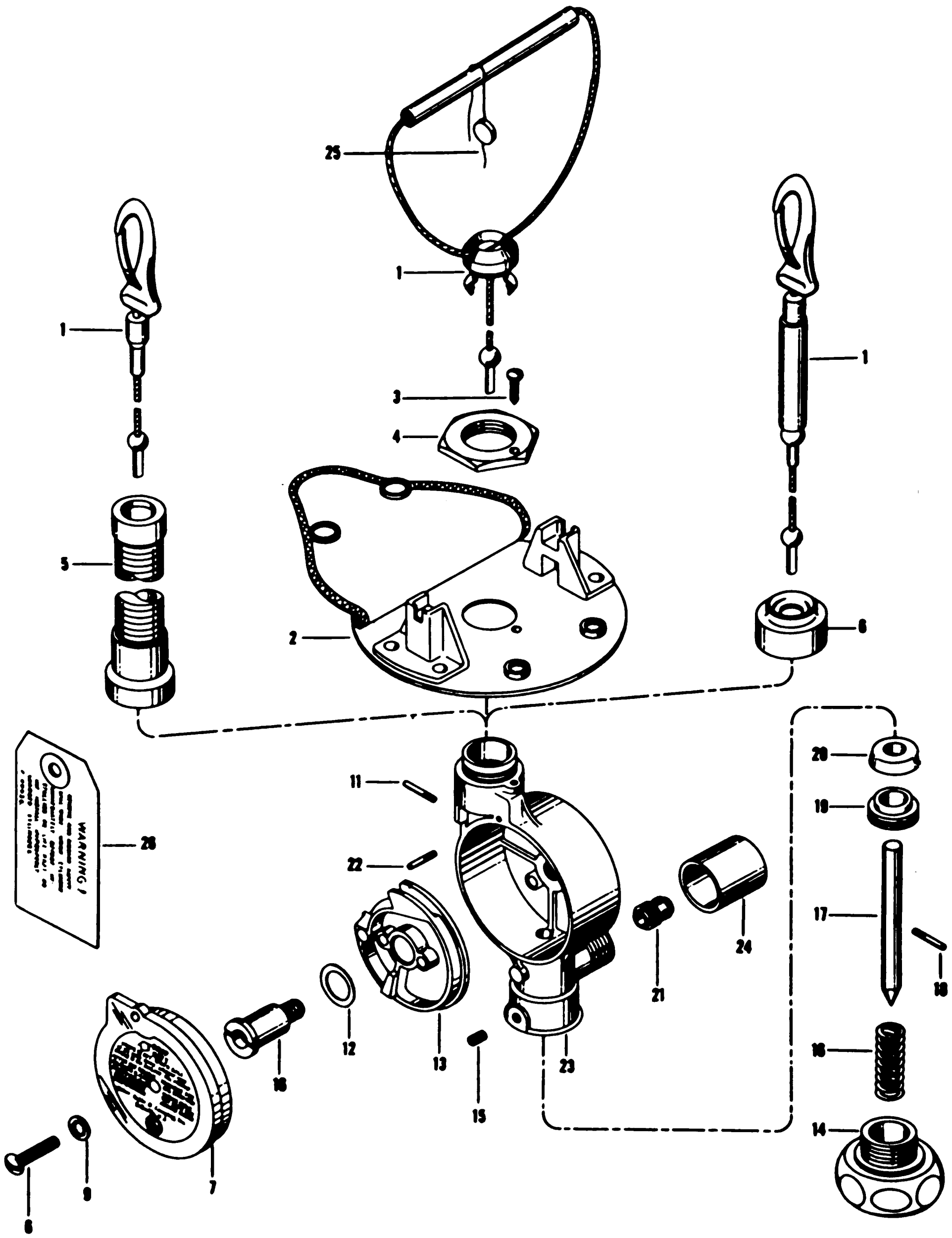


Figure 17-11.—Discharge head assemblies employing cutter type action with hand and remote pull cables

1. Pull cables.
2. Guard flap and plate.
3. Screw.
4. Collar.
5. Cable housing.
6. Cable outlet cap.
7. Nameplate cover
8. Screw.
9. Washer.
10. Stud.
11. Pin.
12. Shim.
13. Cam pulley.
14. Bottom cap.
15. Screw.
16. Spring.
17. Disc cutter.
18. Pin.
19. Packing retainer.
20. U-cup hydraulic packing.
21. Recoil adapter.
22. Pin.
23. Body.
24. Protection cap.
25. Wire seal.
26. Tag.

NOTE: Pull cables (1) are adaptable to remote control systems. The use of one or the other is dependent on its adaptability to a specific aircraft in relation to its life raft inflation system.

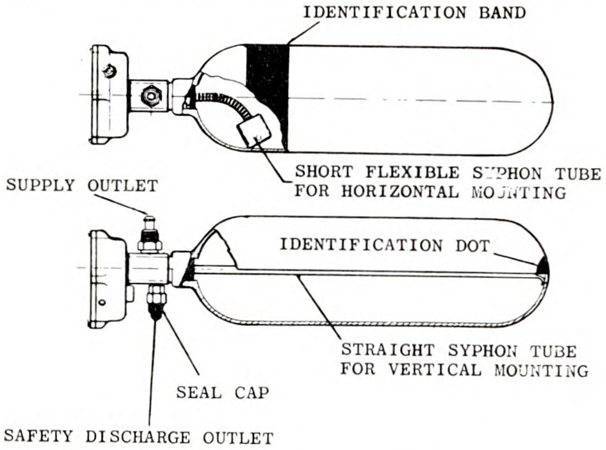

IDENTIFICATION BAND
SHORT FLEXIBLE SYPHON TUBE FOR HORIZONTAL MOUNTING
SUPPLY OUTLET
IDENTIFICATION DOT
STRAIGHT SYPHON TUBE FOR VERTICAL MOUNTING
SEAL CAP
SAFETY DISCHARGE OUTLET

Figure 17-12.—Syphon tubes.

ship are in satisfactory and serviceable condition, periodic inspections should be made, and defective cylinders should be relieved of pressure and turned in to the nearest point in exchange for other cylinders.

The following marks or defects require a cylinder to be turned in for repair:

1. Severely dented, gouged, or corroded.
2. Bulges (deformation from internal pressure).
3. Damaged, split, or leaky seams.

QUIZ

1. Standard carbon dioxide supply cylinders are designed to contain _____ pounds.

   a. 30
   b. 40
   c. 50
   d. 60

2. Recharge equipment will pump carbon dioxide in its

   a. liquid state
   b. gaseous state
   c. vaporous state
   d. liquid-gaseous state

3. What percentage of the liquid in the carbon dioxide supply cylinder is the transfer pump capable of transferring?

   a. 20
   b. 40
   c. 60
   d. 80

4. The carbon dioxide scale is calibrated in increments of ______ pound.

   a. 1/10
   b. 1/100
   c. 10/100
   d. 1/1000

5. The working pressure of a carbon dioxide supply cylinder is ______ p.s.i.

   a. 1,800 - 2,015
   b. 1,800 - 2,500
   c. 1,800 - 2,700
   d. 1,800 - 3,000

6. Carbon dioxide cylinder valves are protected from an excess pressure buildup by a

   a. rupture disc that ruptures at 2,700 - 2,900 p.s.i.
   b. relief valve that opens at 2,700 - 2,900 p.s.i.
   c. relief valve that ruptures at 2,700 - 3,000 p.s.i.
   d. rupture disc that ruptures at 2,700 - 3,000 p.s.i.

7. The two discharge heads most commonly used on life raft inflation cylinders are the

   a. handwheel and manual shutoff
   b. cutter and handwheel
   c. seat and manual shutoff
   d. cutter and seat

8. When recharging a life raft inflation cylinder of the cutter type, it is necessary to replace, prior to recharging, the

   a. sealing disc
   b. safety disc
   c. cutter
   d. piercer

9. Carbon dioxide fire extinguishing equipment cylinders are winterized to operate throughout the temperature range of -65° to -150°F. by the addition of ______ p.s.i. of nitrogen.

   a. 2
   b. 9.40
   c. 150
   d. 200

10. Carbon dioxide cylinders are given a hydrostatic test every
    a. 120 days
    b. 7 years
    c. 5 years
    d. time the cylinder is empty
11. For detailed instructions on recharging specific types of carbon dioxide cylinders, reference should be made to
    a. NA-13-5-501
    b. NA-00-25-513
    c. NA-19-1-501
    d. NA-03-50-517
12. Shatterproof cylinders are identified by a
    a. black stripe on the shoulder
    b. 1-inch white stripe
    c. 2-inch black dot on the bottom
    d. 2-inch white stripe painted on the side
13. Carbon dioxide cylinders are made shatterproof by
    a. the antirecoil fitting
    b. wire wrapping
    c. heat treating
    d. heat treating and wire wrapping
14. All life raft cylinders are equipped with a syphon of the
    a. straight type
    b. flexible type
    c. straight or flexible type
    d. angled type
15. Carbon dioxide cylinders equipped with a straight syphon tube are marked with a
    a. black stripe
    b. white spot
    c. black spot
    d. white stripe

CHAPTER 18

SAFETY BELTS AND SHOULDER HARNESSES

If an award could be given to an item of equipment for the most successful record of saving lives, as well as preserving them, the safety harness (belt and shoulder straps) would take it. Actually, no award would be adequate from a repayment standpoint, as this "famous pair" is forever on the job working to keep airmen in their seats. Keeping a pilot in his seat, away from the danger of falling out or bumping against the interior of a cabin, is a full-time problem, and one that has been met with great success. When wearing a safety harness, pilots can survive many crashes where the cockpit or cabin remains reasonably intact, and the harness will also hold the pilot in the seat during ejection. On installations having the automatic-release feature incorporated, the pilot is held in the seat while being ejected from the aircraft and then is automatically released from the seat after ejection.

What the harness team must offer can be condensed into one statement: The lap belt and shoulder harness combination must be strong enough to hold a man in his seat under all reasonable stress conditions as experienced in high-speed flight, seat ejections, arrested landings, ditchings, or noseover crashes. It must be so designed that it can be released quickly.

Testing and inspecting of safety belts and shoulder harnesses are responsibilities of the Parachute Rigger.

PILOT'S LAP BELT AND SHOULDER HARNESS

Pilot's safety belts may be furnished as complete assemblies, consisting of lap and shoulder straps, or as individual components, as listed in Group 16 of the Navy Stock List. There are several types of lap belts and shoulder harnesses. Figure 18-1 illustrates a complete assembly of one type.

Conventional Lap Belt

Figure 18-2 illustates the pilot's conventional lap belt (MS 22033) showing its stitching pattern, parts assembly, and other significant physical characteristics.

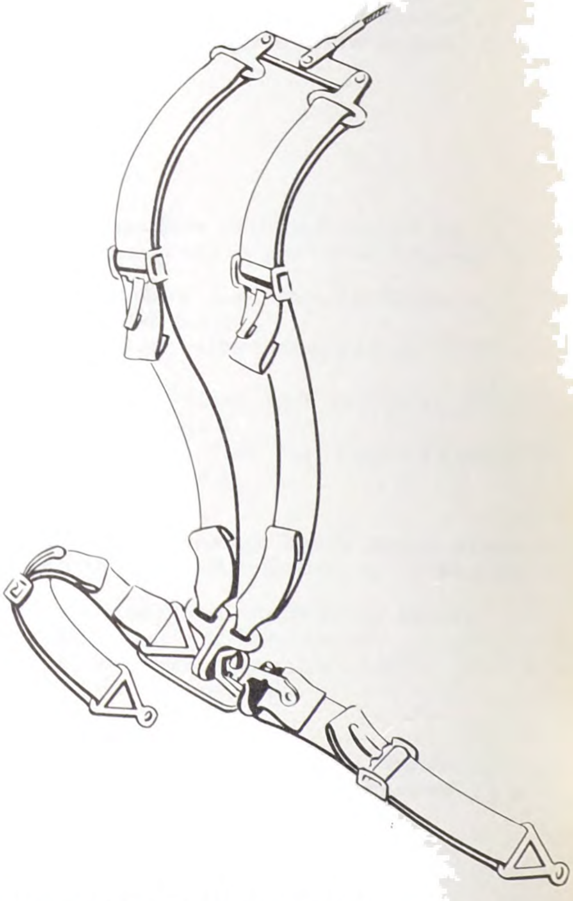


Figure 18-1.—Pilot's lap belt and shoulder harness.

The lap belt is designed to take an ULTIMATE LOAD OF 9,000 POUNDS without failure in the webbing, fittings, or stitched joints; however, a deformation under this maximum load does not constitute a rejection of the manufactured lot. Also, during manufacture, belts are subjected to 6,000 POUND PROOF TESTS. After this test, no excessive deformation of the parts

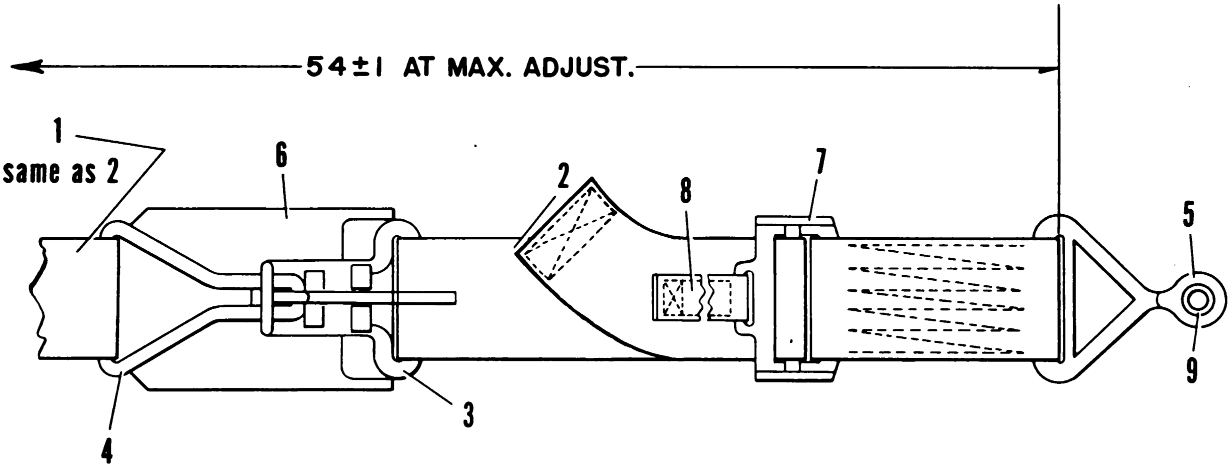


Figure 18-2.—Pilot's lap belt (conventional type).

1. Right side of belt (3-inch nylon webbing).
2. Left side of belt (3-inch nylon webbing).
3. Latch assembly.
4. Link.
5. Loop.
6. Leather protector.
7. Adjuster.
8. Pull tab.
9. Bushing.

or stitching is permitted in the assembly. The latch must work freely when the load is released. The ultimate load and proof load requirements applied to a lap belt immediately after its manufacture (at the plant) should not be confused with the periodic service tests given this equipment in the field. Field test loads do not even approach the tensile strength capacity of the assembled belt. All major stitching is done with 6-cord nylon thread, size E being used in the less important tensile strength areas.

Lap Belt (Automatic-Release Type)

Safety belts installed in aircraft with ejection seats in accordance with installation MS 16036 have an automatic-release feature incorporated. Its function is to hold the pilot in the seat during ejection, then open automatically and arm the parachute acutator after the pilot and seat are clear of the aircraft. This feature is designed to eliminate the necessity of the pilot releasing his safety belt at exactly the proper time and pulling his own ripcord, thus making ejection from an aircraft a much simpler and safer task.

The automatic-release type safety belt is cartridge operated. The complete assembly consists of the two belt halves, link latch, cable assembly, actuator assembly, and actuating unit assembly, as shown in figure 18-3.

When an automatic parachute actuator is used, the cable to the actuator is attached to the belt as shown in figure 18-3. When the belt is automatically separated and the pilot leaves the seat, the parachute actuator arming link is restrained by shoulders on the belt adapter link, pulling the cable and arming the actuator.

Piston action in the actuator assembly pulls the cable which is secured to a link holding the safety belt, shoulder harness and parachute arming wire together. If the automatic release fails to operate, the belt and shoulder harness can be released manually in the normal manner and the pilot must pull his own ripcord.

During normal use, the belt halves are manually joined and separated to attach or free the parachute actuator link so the parachute can be removed from the seat without danger of actuating the automatic actuator.

Shoulder Harness

Figure 18-4 illustrates the H-type shoulder harness' dimensions, its stitching pattern, how it is put together, its parts, and other significant physical characteristics. The Y- and V-types are shown in figure 18-5. Where the lap belt

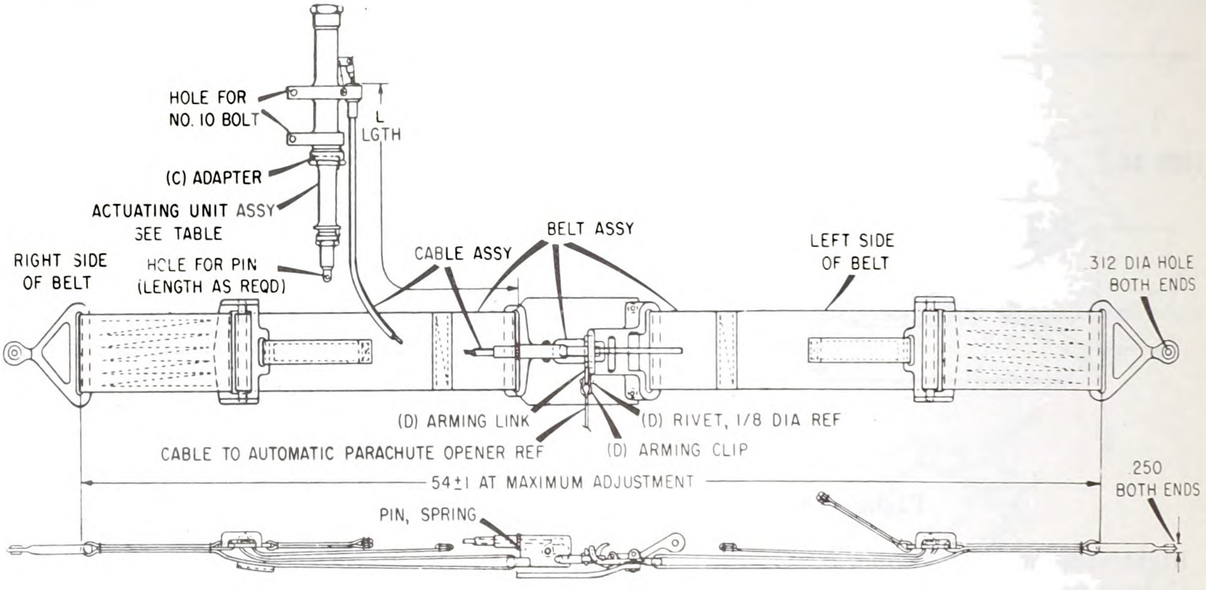


Figure 18-3.—Lap belt, automatic-release type.

remains fairly standard in its attachment to the pilot's seat, the shoulder harness must quite often be modified to fit its anchored location. This subject will be discussed under installation.

The anchor plate of the Y-type is adjustable, making it possible to lengthen or shorten the leg of the harness for a particular aircraft installation. The length of the leg of the Y must be adjusted so that there is adequate shoulder harness adjustment available, yet the crotch of the Y is not on the pilot's neck. During the manufacture and before acceptance, shoulder straps are subjected to a 3,500-pound ultimate load. A reasonable deformation of the parts is permissible.

A proof load of 3,000 pounds is also made and the straps must not have slipped appreciably through the adjustment loops. No noticeable deformation of any kind is permitted in this test. The proof test, then, establishes the highest tensile strength load a shoulder harness will withstand and still operate satisfactorily afterwards. The ultimate test is designed to stop at a tensile strength value just short of complete destruction. With reasonable care and by applying preventive measures, the shoulder harness will give long and honored service, easily passing its field test loads. The latest straps are made of dacron, another new "miracle fiber" similar to nylon. Dacron has less stretch than nylon.

Inertia Reel

The inertia reel is installed on the back of all crewmembers' seats for attachment of the shoulder harness. Its purpose is to allow free movement of the crewmember when in the unlocked position and prevent any forward movement when in the locked position.

The inertia reel must be locked during takeoff, landing, and aerobatics. A force of 2 to 3 g's will lock the reel automatically, depending on the type of reel and direction of the load. Unidirectional reels lock only with g loads applied in a narrow cone along the aircraft's axis. Multidirectional reels lock in almost all directions of applied g loads. The reel pays out 18 inches if in the unlocked position, the position for normal flight.

Figure 18-6 illustrates a currently used electromagnetic inertia reel. With electrical power off, this reel will be locked when the control handle is in either of its end positions. The reel may be released by moving the handle to its middle position.

MISCELLANEOUS SAFETY BELTS

Crewman's Belt

The crewman's safety belt is designed to permit a reasonable amount of movement of the wearer in performing his duties while securely holding him in the aircraft. Figure 18-7 illustrates the MS 16070 belt. An aerial cameraman

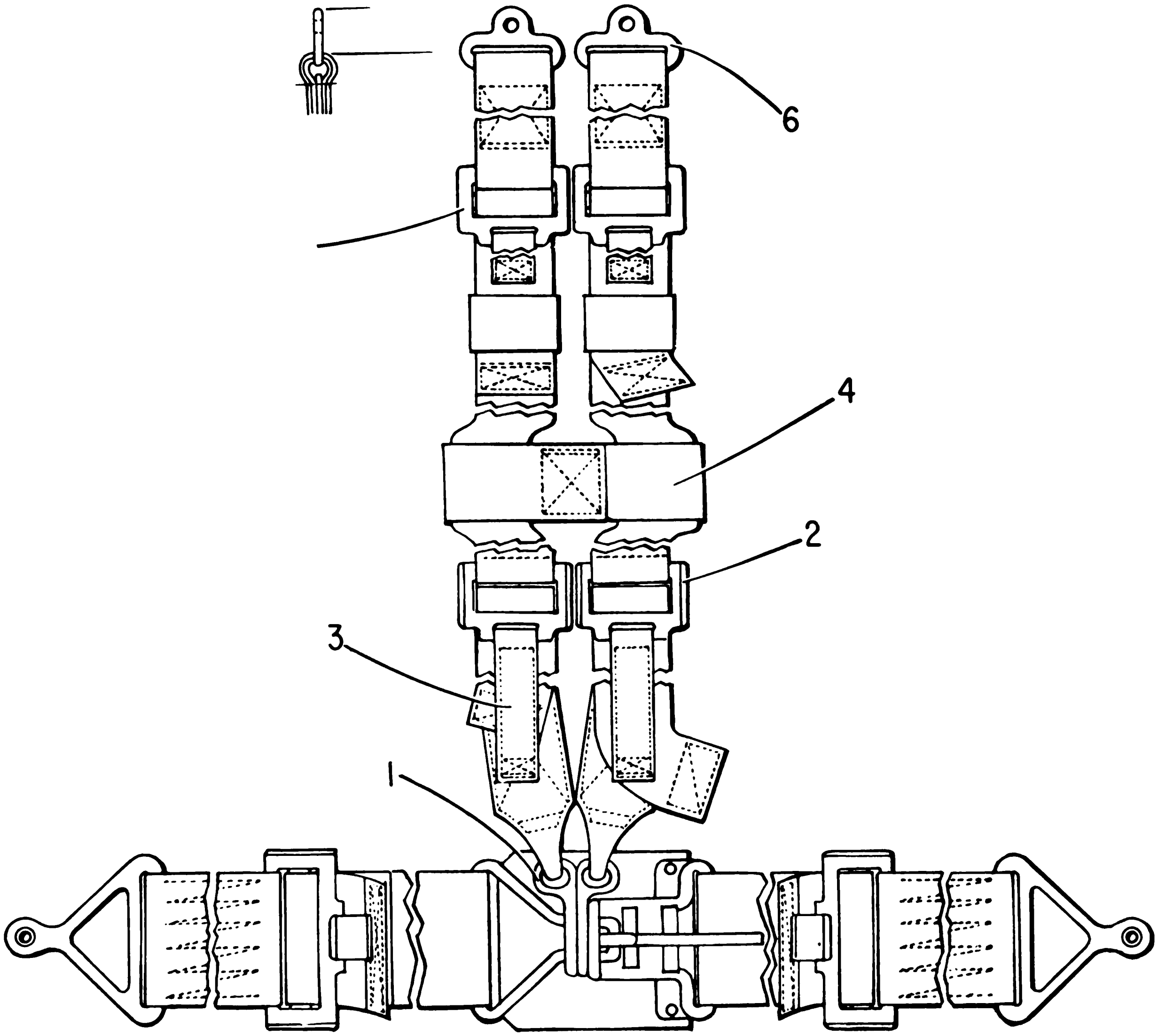


Figure 18-4.—Shoulder harness with separating keeper.

1. Link (left and right).
2. Adjuster.
3. Pull tab.
4. Keeper.
5. Adjuster.
6. Plate attachment.

would use one of these when shooting oblique assignments out of open hatches. The tail strap which is adjustable (22 inches to 65 inches, approximately) can be anchored to any strong part of the aircraft's structure which is adaptable to its hook. Normally the smaller amount of tail strap payed out, the less will be the danger of being whipped about when the airplane is maneuvered violently.

As the crewman makes the attachment, he should anchor to a strong structural member making certain that the attachment will not mar or damage equipment.

Gunner's Belt

The gunner's belt side straps permit more movement than the pilot's type (which is designed primarily to hold him solidly in his seat). The length of the gunner's belt side straps is adjustable, thereby permitting the wearer security in standing as well as in sitting. (See fig. 18-8.)

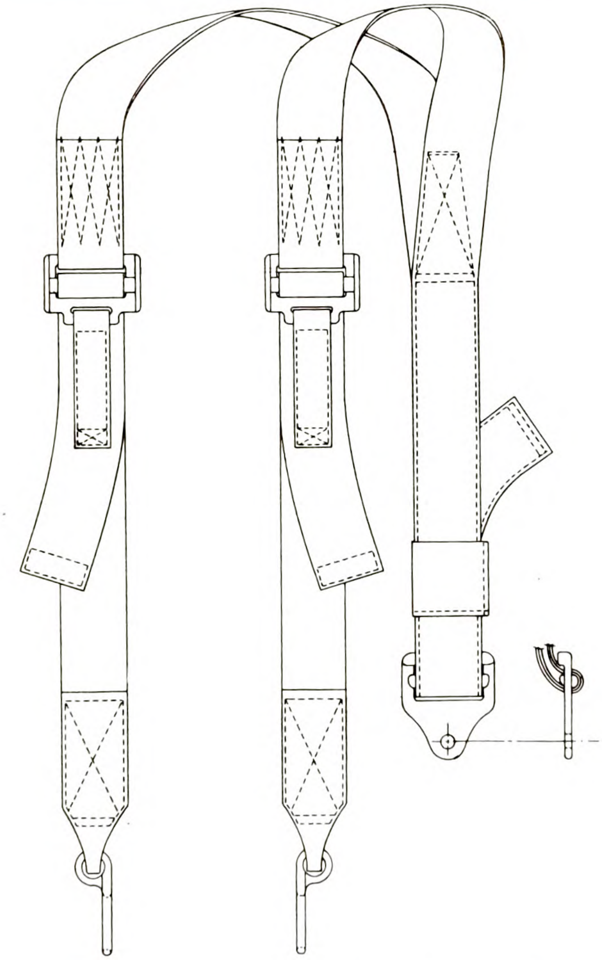


Figure 18-5 (A).—Pilot's shoulder harness—Y-type.

Troop and Passenger Belts

Passenger belts are not used widely in naval aviation. They are installed in certain utility and transport aircraft and in some patrol types. The AN6506 troop belt is more generally specified for combatant type aircraft. Both types of belts have the quick-release feature. The troop belt is designed for an ultimate load of 5,000 pounds while the passenger type is designed to hold up under a load of 4,500 pounds. The webbing of troop and passenger belts is narrower than the pilot's belt, being approximately 2 inches. The AN6506 belt has the same type latching as the pilot's belt; however, the passenger type belt may vary with manufacturers. All major stitching is accomplished with 3-cord nylon thread. Figure 18-9 (A) shows the troop belt, while the passenger type belt and its application are shown in figure 18-9 (B).

INSPECTIONS AND TESTS

Preflight Inspection

Prior to each flight, safety belts and shoulder harnesses are inspected for obvious signs of wear or deterioration of the metal parts and for wear or fraying of the webbing. Release buckles, snaphooks, and other operating parts must be checked for proper functioning.

The following procedure should be followed in the preflight check of inertia reels:

1. Move the shoulder harness inertia reel lock and unlock lever to the unlocked position. Lean forward and back several times. The harness cable should run freely in both directions.
2. While leaning partially forward, move the lever to the locked position. This should prevent any further forward motion. While in this locked position, relaxation at the shoulders should permit backward motion. However, at each bit of backward motion, the inertia reel should ratchet and prevent forward motion from that point.
3. Slowly sit back against the seat. The harness should retract and prevent forward motion.
4. Recheck the locking lever in the locked position and tighten the harness for takeoff.

60-Hour Inspection

After every 60 hours of flight, belts and harnesses are inspected for corrosion and cracks in the metal parts, wear or other signs of deterioration, rotting, cutting, or fraying of webbing, and for proper functioning of the simple release mechanisms.

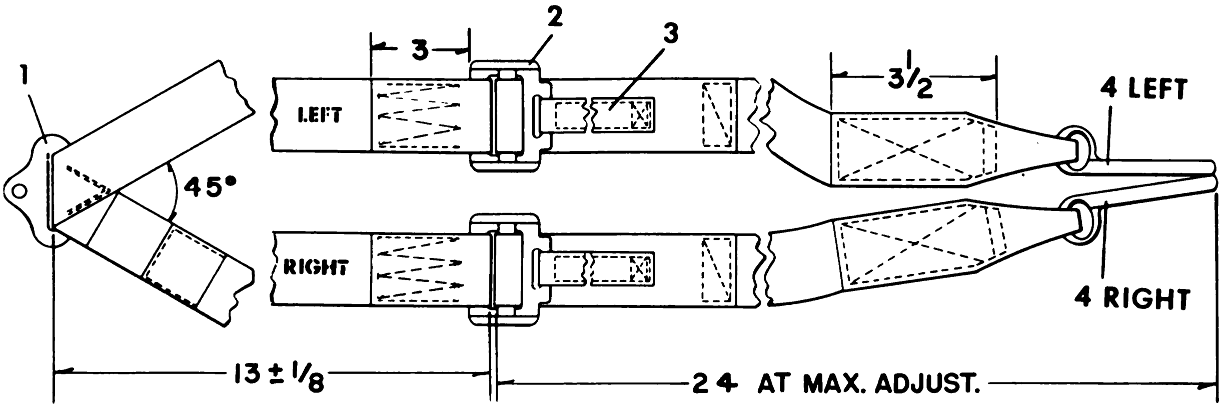
Any part of the aircraft structure securing and coming in contact with the shoulder harnesses and belts must be given a thorough inspection for jagged or rough edges which could cause damage or excessive wear to the equipment. Loose rivets in the anchoring points and other early signs of weakening must be discovered and corrected.

6-Month Inspection

Every 6 months, safety belts and straps are removed from the aircraft, inspected thoroughly, then tested for tensile strength.

The in-service tensile strength tests follow:

1. Pilot's lap type belt—2,750 pounds.
2. Shoulder harness (H- and Y-types)—2,250 pounds tested as a unit. For the H-type—1,125 pounds to each strap tested separately. For the V-type, 2,000 pounds, tested as a unit.



(B)

Figure 18-5 (B).—Pilot's shoulder harness—V-type.

1. Anchor plate.
2. Adjuster.
3. Tab.
4. Links (left and right).

3. Waist band of gunner's belt—2,000 pounds.
4. Slide straps of gunner's belt—1,100 pounds.
5. Troop and transport passenger belts—1,250 pounds.
6. Nonstandard harness, or standard harness used with nonstandard inertia reel, used in helicopters—500 pounds.

V- and Y-type loads must be held for 30 seconds. All others for 60 seconds. After application of the specified loads, there can be no signs of weakening or failure in the metal parts, webbing, or stitching. There must be no perceptible slippage of the webbing through the adjustment loops, and the lap belt release must work freely. The quick release buckle of the lap belt must be operable under a pull of not over 45 POUNDS ON THE LATCH WHILE THE BELT IS SUBJECTED TO A STATIC LOAD OF 400 POUNDS.

In addition to the above mentioned tests and inspections, the automatic-release type belt must be inspected as follows every 6 months:

The entire automatic-release mechanism must be disassembled and inspected, cleaned, and reassembled.

A thin film of preservative oil (MIL-L-3150) should be applied to the firing pin, firing pin sear, and coil spring. Excess oil must be removed to prevent improper action of the firing pin.

The cartridge must be examined for the expiration date. If the expiration date occurs prior to the next scheduled 6-month inspection for the belt, the cartridge must be replaced.

Prior to installing the cartridge, the assembled belt must be subjected to proof load and quick release buckle tests described elsewhere in this section.

Prior to incorporation of the safety wiring, the actuating unit must be torqued to the actuating barrel with 200 inch-pounds to insure that the firing pin, when actuated, will contact the cartridge primer. A minimum of 4 threads must be engaged by the actuating unit.

Periodic Check of Inertia Reel

Periodically, the inertia reel should be given the following checks, the frequency depending on local conditions and directives:

1. After manually locking, then unlocking, pull out the shoulder harness cable to maximum extension and allow it to reel in. Repeat at various amounts of cable extension. The cable should be free to reel in or pull out and should not make a clicking noise.

2. Check the manual control for positive retention of the control lever in the locked and unlocked positions.

3. Place the manual control in the locked position and put a load on the cable by pulling it by hand. The reel should be positively locked. Failure of the inertia reel to hold during crashes, often due to failure of the stalock mechanism, is circumvented by placing the reel

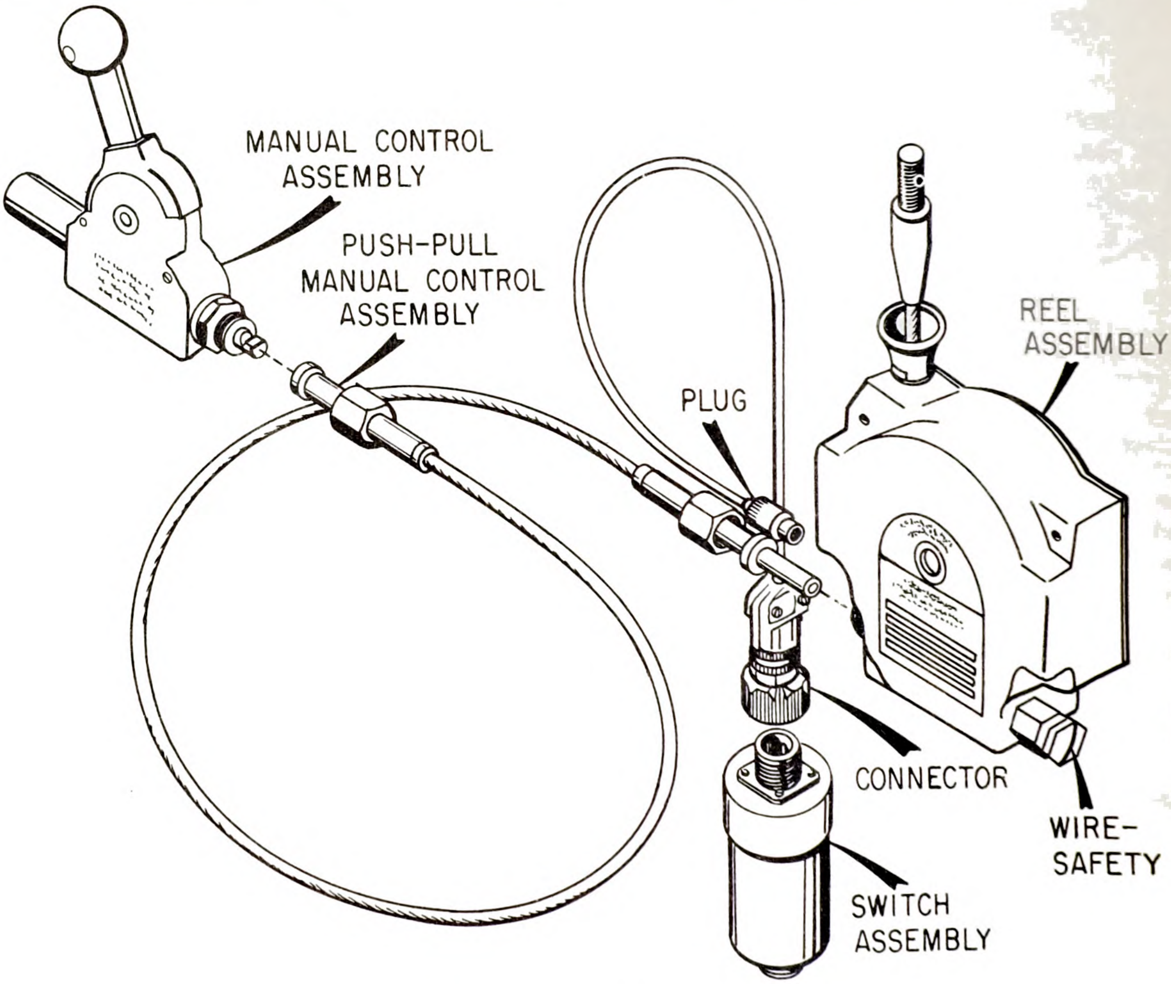


Figure 18-6.—Inertia reel.

in the manually locked position. The manual lock is useful in acrobatics.

4. With no load on the shoulder harness cable against the manually locked reel, move the manual control to the unlocked position. The reel should be free to take up or pay out.

Belt Testing Equipment

Any one of several methods may be used for applying the prescribed proof load to the belts and straps; for example, mechanical tension testers, tripod lifts, deadweight loading, and others. There is no limit to the manner in which the test loads can be applied; accuracy of the actual load is the important thing.

A testing jig made from salvaged material is shown in figure 18-10. Its capacity is approximately 5,000 p. s. i., a necessary reserve in power. The device can be mounted horizontally or vertically depending on the dictates of the physical plant. The movable head and the stationary head should be mounted far enough apart so that all lengths of belts and harnesses together with their necessary mounting clamps or adapters can be accommodated. In many cases, these have to be manufactured locally. Any Parachute Rigger can design the special jig necessary to do the job. For example, the part used in the aircraft to hold the mounting plate of a shoulder harness can be rigged to a testing jig and be used for the same purpose during test.

The device shown in figure 18-10 is adequate. Its construction details need not be followed closely. As a precaution, a wire cage must be constructed and placed over the area that lies between the two attachment heads. Then the

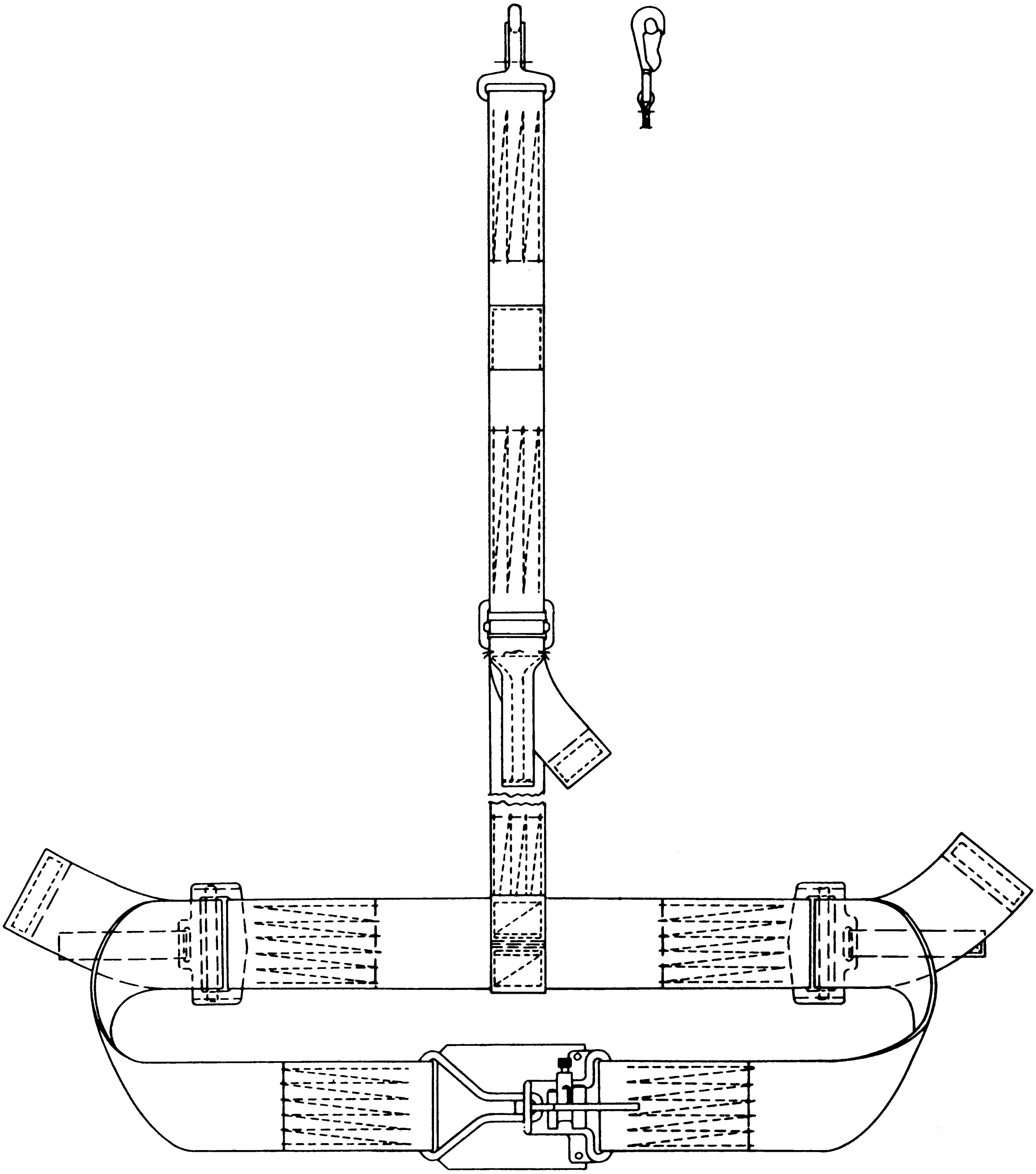


Figure 18-7.—Crewman's safety belt.

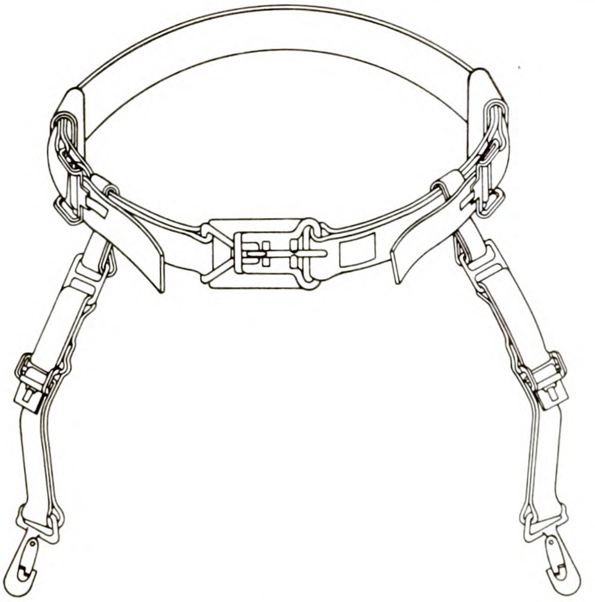


Figure 18-8.—Gunner's safety belt.

operator will be guarded against the possibilities of sudden breakage and the accompanying whipping action that takes place.

CALIBRATION

After construction of a testing device, it will be necessary to recalibrate the pressure gage from p. s. i. to pounds. This will insure an easily read value in relation to the specified tension load. Calibration can be done by any of the methods suggested below. The load in pounds (50-pound increments) can be marked directly on the gage dial, or a chart may be prepared to indicate the equivalent load in pounds for the corresponding p. s. i. graduations.

1. DEADLOAD. Secure the actuating cylinder in an upright position with the piston rod downward. Record the pressure (p. s. i.) required to lift deadloads of known weights.
2. SPRING. Place a large capacity spring scale of known accuracy between the two jaws of the test device and apply pressure. Record the loads in pounds shown on the scale versus the pressure in p. s. i. indicated by the gage.
3. DYNAMOMETER. Place a loop or Chatillon dynamometer of approximately 5,000 pounds capacity between the two jaws of the testing device and apply pressure. Record the load in pounds against the p. s. i. indicated by the gage.

OPERATION

The device requires only one man to operate it. Secure one end of the belt or shoulder strap to the ratchet rod and the other end to the piston rod. The length of the adjustable ratchet and the piston rod will afford sufficient clearance for testing belts of various lengths. Turn the selector valve handle to the loading position. Apply the required load by operating the hand pump. Read the load on the calibrated gage. Hold for 30 seconds or 1 minute, as specified for the particular harness, and release the load by turning the selector valve handle to an unloading position.

Recalibrate the gage every 6 months; breakages in the system should be repaired as they occur. Replenish the oil supply when needed.

Safety belts and shoulder harnesses found to be damaged or unable to withstand the strains

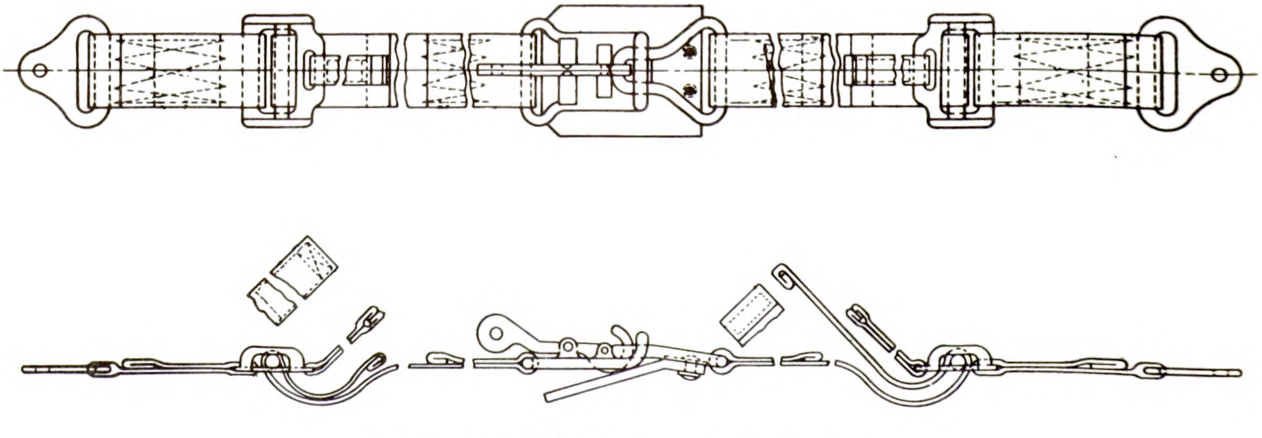


Figure 18-9 (A).—Troop type safety belt.

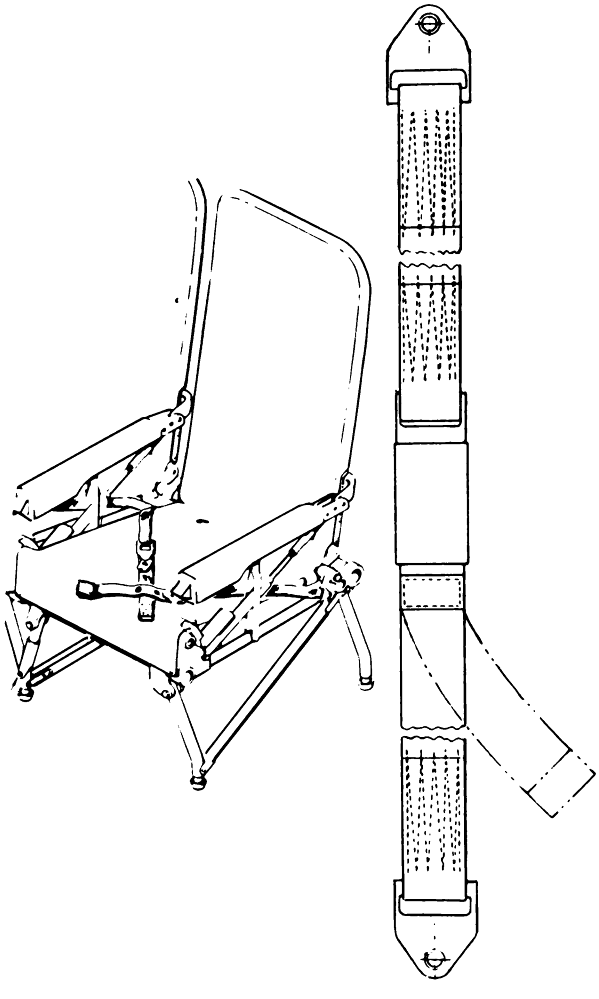


Figure 18-9 (B).—Passenger type safety belt.

of testing should be replaced with the latest equipment.

Figure 18-11 illustrates the application of a testing jig to the harness. The jig is adaptable to Y- and V-type shoulder harnesses, also the H-type. The anchoring adapter shown in figure 18-11 is not made in accordance with a specified drawing. However, the important thing to consider is its adaptability to the type belt or strap arrangement being tested. As long as an anchoring adapter does not produce any twists or undue strain on the article under test, it may be considered adequate.

INSTALLATIONS

The anchoring points of safety belts and harnesses quite naturally vary with different type airplanes; and when we consider the pilot's seat, copilot's, navigator's, flight engineer's and others in larger aircraft, we can visualize the installation problems. Specific information can be found in the aircraft's manuals.

Regardless of the occupant of a particular station, there are a few simple principles that can be applied to the installation of all safety harnesses. Some texts refer to the entire arrangement (safety belt and the shoulder harness) as being the safety harness, while others only mean the shoulder harness. Whenever following installation directions, be certain you know the part being referenced. Since the belt and shoulder straps have been designed to withstand a terrific amount of stress (more than human endurance), it is only reasonable to match the anchoring points with the tensile strength of the entire safety harness. This is done by the manufacturer, BUT THE SECURITY OF THE ANCHORING DEVICES CAN BE LOST BY A POOR INSTALLATION.

The general installation rules are as follows:

1. Where applicable, use only steel bolts and nuts.
2. Use only stop nuts, or the castellated type, which require a cotter pin through the bolt and castellations of the nut to prevent loosening.
3. Apply nuts, especially the type requiring a cotter pin, in such a way that they will not catch on the parachute or clothing.
4. Whenever possible, belts and harnesses must be installed without interruptions in their "fair lead" (a course of running or standing line, webbing, or cable that avoids all chafing). Certain designs make this impossible, and when such is the case, make certain the webbings being carried in a new direction are placed over the top of a strong structural member, whether it be on the seat or some other part. The structural member, acting as a guide, must be smooth.
5. The installation must not interfere with other equipment and the escape procedures outlined for a specific aircraft. In no way must the path of an ejection seat be obstructed.
6. To establish the correct relationship, left sides of belts and shoulder harnesses are installed on the left side of the seat as viewed from its rear. Not all seats face forward in an aircraft.
7. All belts must be installed with the manual release latch on the left side so that they can be released with the right hand. Excess webbing lengths can be cut from belts and straps, provided everyone (all sizes) can be served adequately by the assembly. Whenever

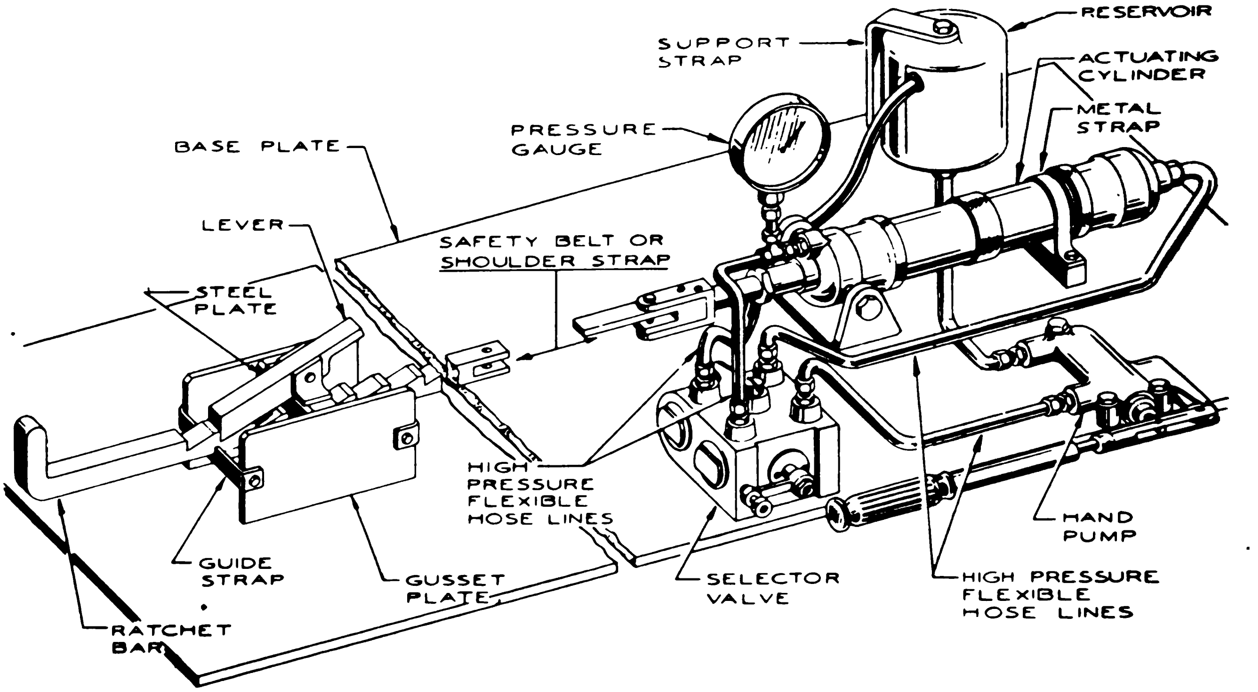


Figure 18-10.—Safety belt and shoulder harness testing jig.

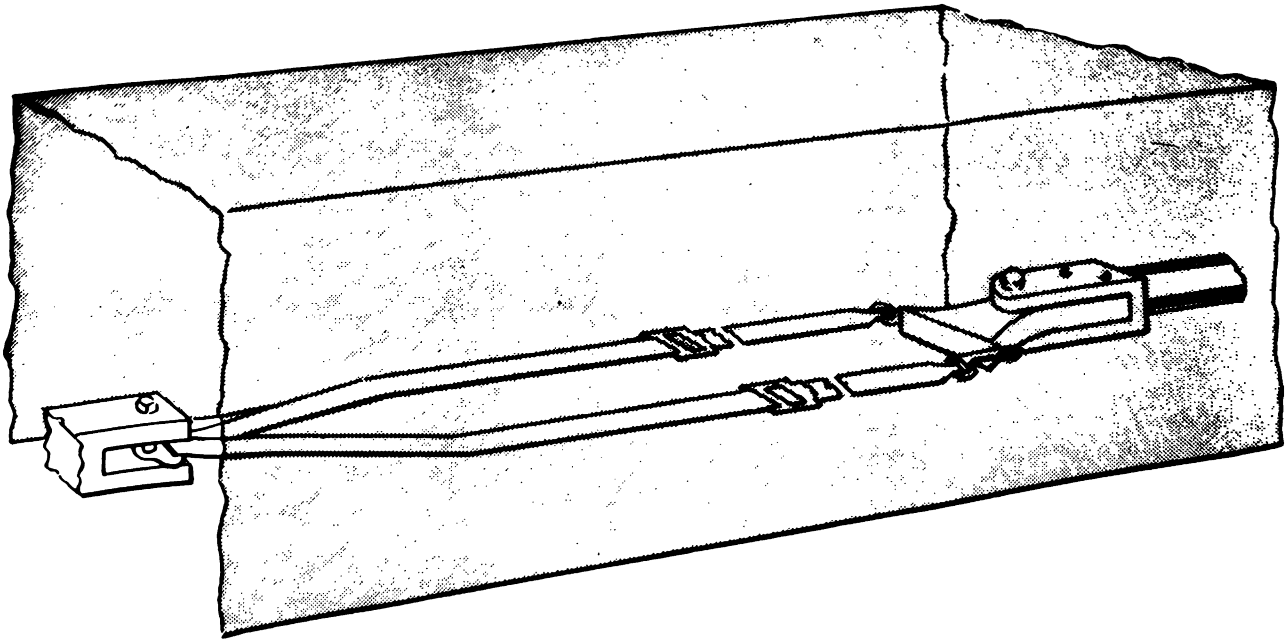


Figure 18-11.—Application of jig to shoulder harness.

the ends of the webbing are shortened, they must be properly folded or doubled and then sewed with the proper size cord as specified by the manufacturer of the equipment.

8. Prevent the danger of loose webbing ends being dragged free from their adapters. Do not permit short loose-end conditions following a long-reaching adjustment. In some cases, it may be advisable to make a tacking in a webbing assembly to prevent this dangerous slippage. In doing it, strike a universal or midway position of the shoulder adapters in relation to the collarbone area of short and tall pilots. The shoulder adapters of the shoulder harness should be adjusted in such a way that they fit just below a man's collarbone and not over it. Over the collarbone, they can cause bruising and are therefore uncomfortable.

9. The hardware used in the assemblies must be so designed to prevent chafing the webbing. Any filing of rough edges must be accompanied by a plating process to prevent rust.

Figures 18-12 and 18-13 illustrate two typical examples of a complete safety harness installation in an attack type aircraft. Notice the location of the inertia reel controls in figure 18-13.

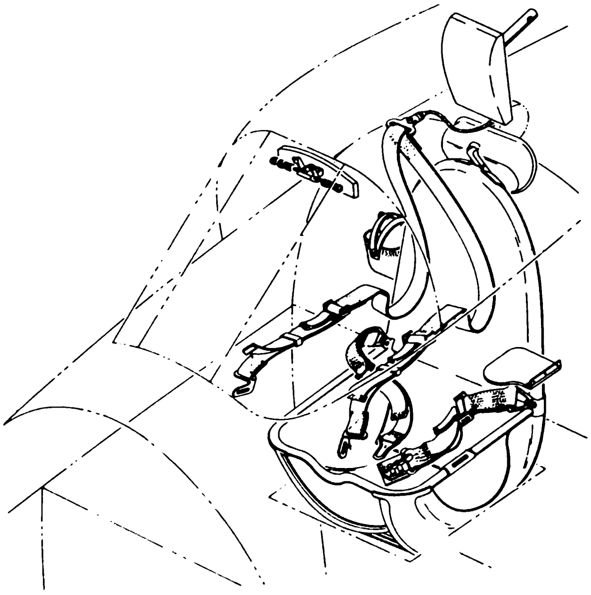


Figure 18-12.—A pilot's safety belt and shoulder harness installation.

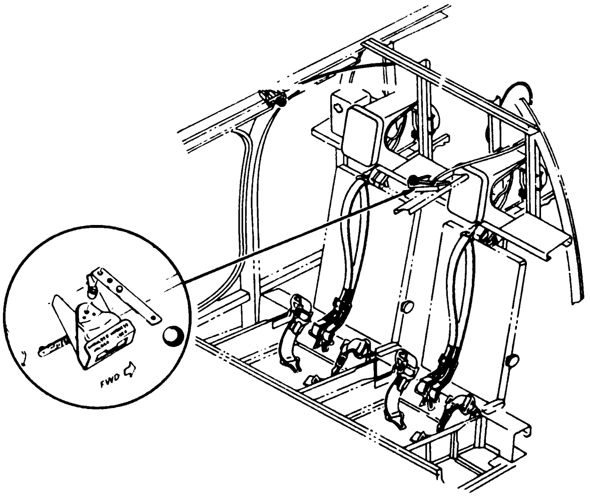


Figure 18-13.—Crewman's safety belt and shoulder harness installation.

QUIZ

1. Safety belts and shoulder straps are listed in Group
   a. 16 of the ASO Catalog
   b. 60 of the Navy Stock List
   c. 60 of the ASO Catalog
   d. 16 of the Navy Stock List
2. During manufacture, belts are subjected to
   a. an ultimate load of 7,000 pounds
   b. an ultimate load of 5,000 pounds
   c. proof tests of 6,000 pounds
   d. proof tests of 9,000 pounds
3. The pilot's lap belt is made of
   a. 3-inch nylon webbing
   b. 4-inch nylon webbing
   c. 5-inch nylon webbing
   d. Type VIII nylon webbing
4. All major stitching of the lap belt is made with
   a. 4-cord nylon thread
   b. 5-cord nylon thread
   c. 6-cord nylon thread
   d. E nylon thread
5. During the 60-hour inspection, the crewman's belt is subjected to
   a. a specified load of 1,250 pounds
   b. a specified load of 2,000 pounds
   c. a specified load of 2,750 pounds
   d. no specified load

6. The shoulder adapters of the safety harness should fit
   a. just below the collarbone
   b. just above the collarbone
   c. on the collarbone
   d. wherever they are most comfortable

7. An unlocked inertia reel, if operating properly, should
   a. reel in, only, with a clicking noise
   b. pull out, only, with a clicking noise
   c. reel in and pull out freely with a clicking noise
   d. reel in and pull out freely without making a clicking noise

8. When testing V-type shoulder straps, the load is held for
   a. 30 seconds
   b. 30 to 60 seconds
   c. 60 seconds
   d. 30 minutes

9. The inertia reel will lock automatically
   a. on landing and takeoff
   b. on landing only
   c. if subjected to a force of 2 to 3 g's
   d. at all times

10. The automatic-release safety belt is
   a. electrically operated
   b. hydraulically operated
   c. operated by compressed air
   d. cartridge operated

11. The actuating unit on the automatic-release safety belt must be
   a. torqued to 32 inch-pounds
   b. torqued to 200 inch-pounds
   c. safety wired with 0.048 copper wire
   d. safety wired with 0.052 copper wire

12. The automatic-release belt is designed to
   a. release the pilot from the aircraft
   b. fire the canopy
   c. automatically separate the pilot from the seat and arm the parachute after ejection
   d. release automatically upon landing

13. During the 6-month test, the pilot's lap belt is subjected to a specified load of ______pounds.
   a. 500
   b. 1,250
   c. 2,000
   d. 2,750

14. During the 6-month test, the passenger's belt is subjected to a specified load of ______pounds.
   a. 500
   b. 1,250
   c. 2,000
   d. 2,750

15. The capacity of the harness testing device is______pounds.
   a. 2,750
   b. 3,000
   c. 5,000
   d. 6,000

16. When calibrating the harness testing device, the load is marked directly on the gage dial in____pound increments.
   a. 10
   b. 50
   c. 100
   d. 500

17. When testing a crewman's safety belt, the specified load is sustained for
   a. 30 seconds
   b. 30 to 60 seconds
   c. 60 seconds
   d. as long as the operator thinks necessary

18. Before acceptance, shoulder straps are subjected to a proof load of______pounds each.
   a. 1,125
   b. 2,000
   c. 2,250
   d. 3,000

19. The tail strap of the crewman's belt is adjustable to
   a. approximately 20 to 65 inches
   b. exactly 22 to 60 inches
   c. approximately 22 to 65 inches
   d. exactly 22 to 65 inches

20. The most likely person to use the crewman's belt would be the
   a. pilot
   b. radioman
   c. waist gunner
   d. aerial cameraman

21. All major stitching in shoulder straps is done with
   a. 3-cord nylon thread
   b. 5-cord nylon thread
   c. 6-cord nylon thread
   d. E nylon thread

22. During the 6-month test, with the belt subjected to a 400-pound load, the latch must open under a pull of not over____pounds.
    - a. 22
    - b. 40
    - c. 45
    - d. 50

23. The actuating unit of the automatic-release lap belt assembly is torqued to the actuating barrel so that
    - a. it will not vibrate loose
    - b. it cannot be opened by hand
    - c. safety wiring will not be essential
    - d. the firing pin, when actuated, will contact the cartridge primer

24. When installing lap belts,
    - a. only nuts with left-hand threads are used
    - b. any type nut may be used
    - c. only elastic stop nuts may be used
    - d. only stop nuts or the castellated type which require a cotter pin may be used

25. When installing a lap belt, the latch
    - a. must be on the left side
    - b. must be on the right side
    - c. may be on either side
    - d. is secured with a stop nut

APPENDIX I

GLOSSARY

ACTUATOR, AUTOMATIC PARACHUTE.--A device designed to automatically withdraw the ripcord from a parachute.

ADAPTER.--A metal buckle-like part used in conjunction with parachute harness and webbing straps primarily as an anchoring point. It has little value as an adjusting device since the advent of quick adjustable hardware.

ADAPTER, QUICK FIT.--Hardware used in conjunction with harness chest straps. This adapter is designed with a sliding, locking bar for adjustment purposes.

APEX.--Highest point; top of the canopy.

ARM, SEWING MACHINE.--The sewing machine arm (molded metal section of the head) houses the arm shaft and supports the faceplate housing at the opposite end from the uprise together with its internal parts. The arm is suspended from the top of the uprise horizontally above the bed of the machine.

ASSEMBLY, RIPCORD HOUSING.--Ripcord passes through the housing which guides and protects the ripcord cable.

BAG, CHAFING.--A parachute bag, sometimes called a traveling bag.

BALL, CABLE RETAINING.--This ball is used in the manufacture of ripcords and is used to secure the grip to the ripcord cable.

BAND, PACK OPENING.--Coil springs arranged in parallel and cloth covered. Hooks join the series at each end. Bands are fastened to the pack and draw back the sides and ends of the pack after the ripcord has been pulled. Each opening band is a complete and separate assembly.

BAR, SPREADER.--Flat metal hooks used to retain the parachute under tension during part of the packing process.

BODKIN.--A flat, blunt-end, large-eye needle used for inserting tape, tie cords, and the like, into casings or channels.

BOTTOM, DOUBLE.--A false bottom; a second bottom panel in the pack.

BOTTOM, FALSE.--The inner bottom piece of the parachute pack carrying the hesitator loops.

CANOPY, CONICAL.--The peak of the 26-foot 22-gore canopy is more cone-shaped than older service type canopies, and when inflated may easily be identified by its raised portion at the top.

CANOPY, 28-FOOT, RIPSTOP, NYLON ASSEMBLY.--Used on service parachutes as the main body or sail of the parachute, capable of resisting the air and providing a safe rate of descent for an individual of average weight.

CANVAS.--A heavy, closely woven cloth of hemp or flax, used for tents, sails, covers, and the like; also a similar cloth of tow, jute, or cotton.

CHUTE, ANTISPIN.--A small parachute used in certain aircraft to correct or prevent a spinning motion.

CHUTE, DECELERATION.--A parachute used to reduce the speed of an aircraft after landing.

CHUTE, CARGO.--A parachute used for dropping supplies and equipment, an Air Force specialty.

CLOTH.--A pliable fabric, woven, felted, or knitted from any filament; commonly fabric of woven cotton, woolen, silk, nylon, rayon, or linen fiber.

CONE, LOCKING.--Small, metal, conical piece of hardware sewed to pack, forms part of releasing device. Used in conjunction with side flap grommets and ripcord pins. This device holds the pack closed and also permits a safe and smooth opening when the ripcord pins are released.

CONSTRUCTION, BIAS.--The warp of the material is placed at a 45-degree angle to the centerline of the gore of the canopy instead of running straight up and down, parallel to the centerline. This type of construction offers a great amount of resiliency which is an important characteristic to the parachute.

CONSTRUCTION, STRAIGHT.--Cloth cut and sewed parallel to the warp and filler (woof) threads of the weave.

CUSHION, BACK ASSEMBLY.--A thin, cloth-covered, sponge-rubber pad attached to the harness to provide comfort.

CUSHION, SEAT ASSEMBLY.--A square cloth-covered cushion, equipped with a slot to provide passage for the harness leg straps.

DECELERATE.--To slow down. A free-falling body will decrease its rate of descent due to pressure of the atmosphere against its frontal area. This resistance will gradually increase as the falling body nears the earth due to increasing atmospheric pressure.

DENIER.--A unit of measurement of silk in which the size of yarn is quoted as its weight per length. This is determined by weighing 9,000 meters and quoting the size of the yarn in grams. Thus, if 9,000 meters weigh 30 grams, the size of the yarn is then known as 30 denier.

DIAMETER, PROJECTED.--The inflated diameter of the parachute. The inflated diameter is less than the flat diameter.

DUCK.--A linen or cotton fabric, finer and lighter than canvas, but similar to it.

DUMMY, PERSONNEL PARACHUTE.—A weight used for testing parachutes. The weight of a dummy varies from 150 to 400 pounds depending on the types of tests to be conducted. Torso-shaped dummies are used when the harness is being tested.

EXTENSION, PEAK.—A length of webbing fitted with a hook on one end. Several grommets, equally spaced throughout the unit's length, provide for fastening the peak of the canopy under tension during part of the packing process.

EYE.--Wire anchoring device designed to receive hooks. ''Hooks and eyes.''

FASTENER, PACK TAB (OVAL).--Metal device located on both ends of parachute pack. End tabs are passed over locking cones to hold ends of pack closed.

FASTENER, SLIDE.--A zipper.

FASTENER, SNAP.--Metal fastening device usually consists of four parts: button, socket, stud, and eyelet. Device is manufactured in various shapes and sizes.

FERRULE.--Device which provides a strong and smooth finish on the ends of a ripcord housing.

FITTING, SWAGED.--A fitting attached to an object by a pressure process involving special tools and dies.

FRAME, PACK.--Metal wire frame used to give chest and seat type parachute packs shape and rigidity.

GORE.--That portion of the 28-foot canopy contained between two adjacent radial seams. This area is triangular and consists of four sections or panels and is bordered by two radial seams, a skirt at periphery edge, and a vent collar at the peak.

GRIP, RIPCORD ASSEMBLY.--Handle secured to ripcord cable and held in a pocket usually located on the harness. A ''pull'' on the grip will operate the parachute. The grip is often referred to as the ''hand pull.''

GROMMET AND WASHER.--Metal device used to reinforce holes in fabrics. The shank of the grommet passes through a hole in the washer and is crimped over it in the setting process.

HARNESS.--The webbing assembly securing the wearer to his parachute and worn on the body encompassing the shoulders, back, chest, hips, and groin.

HEAD, SEWING MACHINE.--The head is the entire metal housing which supports the moving parts and bearings of the machine.

HEM.—A hem merely serves as a means of finishing an edge.

INDEX, PARACHUTE.--List of parts and part numbers required to manufacture each type of parachute. Indexes are furnished by the Naval Aircraft Factory.

KEEPER, BRIDGE.--Device used in closing the lock chain parachute pack.

KEEPERS.--Fabric guides used to hold various appendages of the parachute in place.

KNEE LIFTER, SEWING MACHINE.--The knee-lifting mechanism operates the presser foot and/or pressers, up and down through a series of linkages starting from the underside of the machine table.

KNOT, SURGEON'S.--A square knot executed with two turns instead of one in the first step of tying the knot. The extra turn temporarily provides additional holding power so the hands are free to accomplish the second step.

LINE OVER.--A type of simple foul occurring during the opening of the parachute. One or more suspension lines partially passed over the top of the canopy reduces the projected diameter and can have a serious effect on the rate of descent.

LINE, STATIC.--A length of webbing or similar strong purchase secured to the releasing device and to a structural part of the aircraft for dropping cargo and paratroop personnel.

LINES, SUSPENSION.--Network of nylon braided lines which connects the canopy to the harness. The number of suspension lines varies with the diameter of the parachute. (Sometimes called SHROUD LINES.)

LINK, REMOVABLE CONNECTOR.--Hardware used to secure the suspension lines of the risers of the harness or lift web assembly of a quick attachable parachute.

LINK, TRIANGLE.--Hardware used in conjunction with a snap to secure the harness.

LOAD, PROOF.--The testing of an item for conformance with strength requirements.

LOAD, SHOCK.--The maximum load or stress to which the parachute and its components are subjected during the second stage of inflation of the canopy.

LOCKSTITCH.--Type of stitching used in manufacturing parachutes. This type of stitch is formed by two threads. A loop of the thread is passed through the material where it is entered by the supply of the other thread. The loop of the first thread is drawn into the material to the extent that the loop or lock is approximately halfway between the two surfaces of the material. This is a type 301 stitch.

LOOP, PILOT CHUTE.--Loop formed at the bottom of the pilot chute suspension lines used to secure it to the main canopy.

LOOPS, HESITATOR.--Retain the suspension lines in a neat and orderly arrangement in the parachute pack. These loops are made in varying sizes and materials.

MATERIAL, BOLT OF.--A compact package or roll of cloth, usually about 40 yards.

MERCERIZED.--The treatment of cotton fiber or fabrics with a solution of caustic alkali to make the fiber stronger and more receptive to dyes, often in a way to give a silky luster.

MOTOR, ELECTRIC, 3-PHASE.--A 3-phase electric motor requires relatively little maintenance, due to its design and construction characteristics. It is more adaptable for use on industrial type sewing machines. Maintenance problems, other than simple lubrication, are the responsibility of an electrician.

NEEDLES.--There are three common types of needles used for general hand sewing: sharps, betweens, and crewels.

NYLON.--A synthetic material of protein-like structure derived from coal, air, and water, which is adapted for fashioning into filaments of extreme toughness, strength, and elasticity, and used in the manufacture of parachutes.

NYLON, RIPSTOP.--A type of weave designed to prevent tears from spreading. Extra numbers of yarns are closely woven into the cloth intermittently across the width and across the length.

NYLON, TUBULAR.--Sleeve-like weave, seamless, and pressed flat, similar in appearance to tape, but stronger and hollow in the center.

OSCILLATIONS, PARACHUTE.--A pendulum-like action of an inflated canopy during descent.

PANEL.--Same as a section of a gore.

PARACHUTE, FLAT TYPE.--Reference is directed to the type of canopy construction which will lie perfectly flat when stretched out. A formed type canopy will not lie flat.

PARACHUTE, MANUALLY OPERATED.--A parachute operated by the wearer. The ripcord must be pulled by hand to release the parachute after the jumper is in the air and free from the aircraft.

PARACHUTE, STATIC LINE OPERATED.--A parachute operated by a length of webbing after a jumper has fallen the length of the static line. The ripcord pins are pulled from the pack, the parachute opens, and a "break tie" breaks, freeing the parachute.

PARAFFIN.--A flammable, waxy substance produced by distilling wood, shale, coal, etc., and also occurring in the earth as a constituent of petroleum or as a solid deposit.

PARTS LIST, SEWING MACHINE MANUFACTURER'S.--The proper nomenclature for every part of a particular sewing machine can be found in the manufacturer's List of Parts.

PERMEABILITY, AIR.--A measure of the rate of flow of air through fabric, denoted in cubic feet of air which will pass through a square foot of fabric in one minute under a certain pressure drop.

PILOT PARACHUTE.--Small auxiliary parachute secured to the peak of the main canopy designed to hasten the opening of the main canopy.

PIN, LOCKING.--This part is used in the manufacture of ripcords by swaging methods and is used to hold the parachute in a closed position. A "pull" on the ripcord will cause the pins to be withdrawn from the locking cones.

PLEATS, ACCORDION.--Multiple folds of cloth placed one upon the other.

POCKET, LOG RECORD.--Parachute pack pocket used to hold packing data card and signal code. Each pack contains two pockets, one is sewed to the inside of the pack and the other is located on the outside.

POCKET, RIPCORD HANDLE.--Elastic or spring edged pocket holds ripcord handle in an accessible position on the harness. The chest type pocket consists of a piece of straight elastic webbing serving the same purpose.

POLYGON.--A figure generally plane and closed, having many angles and hence many sides; one having more than four sides.

POROSITY.--The state or quality of the fabric being porous. This is controlled by the weave of the fabric which determines the permeability of the cloth by the measurement of an airflow.

PULL, CLOVERLEAF HAND.--Resembling a cloverleaf. This shape grip is used on all chest type parachutes and on some training back type parachutes.

RELEASE, BAROMETRIC PRESSURE.--A spring wound device for automatically opening a free-fall type parachute, operating on the differences of barometric pressure in conjunction with a timing element.

RELEASE, QUICK.—A device for releasing the canopy from the rest of the parachute.

RING, D.--Metal D-shaped hardware used in conjunction with parachute harness, provides attachment points for chest type parachute.

RING, PULL.—See ripcord assembly grip.

RING, V.--Used in conjunction with snaps to fasten the harness around the wearer. Same use as the newer triangle link but different in shape.

RING, VENT.—A molded elastic ring, enclosed in the hem of the vent collar. This holds the vent partially closed and free to expand with varying pressures (28-foot canopy).

RIPCORD.--Releasing device used to operate the parachute. Ripcords are designed in varying lengths and handgrips. The length of the ripcord and shape of the grip depends on the type of parachute.

RISERS.--Lift webs, or that webbing section of the harness coming in contact with the removable connector links which join the canopy to the harness. A lift web assembly is a separate assembly, and is not to be confused with the "fixed" reference given this part for the seat and back type parachutes. The chest type parachute carries a lift web assembly as a complete unit.

SAIL.--Main body of cloth of pilot chute and parachute canopy.

SEAMS.—Seams join two pieces of fabric together.

SEAMS, DIAGONAL,--Lateral or cross seams joining the sections or panels of a gore and cut at an angle of 45 degrees to the centerline of each gore.

SEAMS, RADIAL,--Seams radiating from vent to skirt, joining gores. These form channels for the suspension lines on 28-foot canopies.

SEWING MACHINE 111 W 150.--A high-speed, single needle, lockstitch, compound feed machine employing a belt driven rotary hook with a vertical axis. The machine has ball bearings on the upper and lower shafts and in the hook saddle. It is designed for stitching medium fabrics and is used in the manufacture and repair of parachutes, clothing, and numerous other articles. It is driven by a 1/3-hp. motor which operates on a 60-cycle, 3-phase current at 1,725 r.p.m. It has an arm clearance of 10-1/2 inches and a bed length of 18-3/4 inches. A complete unit consists of a machine head, a table, and a stand.

SEWING MACHINE 111 W 155.--A single needle, lockstitch, compound feed machine with a vertical-axis rotary type sewing hook, and alternating pressers having 1/2-inch lift. It has a safety clutch which prevents the hook from being damaged or getting out of time due to accidental strain. The maximum stitch length is 3-1/2 to the inch and it has an adjustable lifting eccentric to instantly set the alternating pressers to the minimum amount of lift required for the work to be sewed. This machine is not adaptable for sewing very lightweight fabrics such as bunting, fluorescent cloth, and nylon. It is driven by a 1/3-hp. motor which operates on a 60-cycle, 3-phase current at 1,725 r.p.m. It has an arm clearance of 10-1/2 inches and a bed length of 18-3/4 inches. A complete unit consists of a machine head, a table, and a stand.

SEWING MACHINE 31-15.--A single needle, lockstitch, drop feed machine with a horizontal-axis sewing hook operated in an oscillating motion. The machine is intended for stitching lightweight fabrics such as bunting, fluorescent cloth, and nylon. It is driven by the same motor as the 111 W 150, has an arm clearance of 10-1/4 inches, and a bed length of 18-3/4 inches. A complete unit consists of a machine head, a table, and a stand.

SEWING MACHINE 7-31.--A single needle, lockstitch machine with oscillating type sewing hook designed for sewing heavy canvas and other similar work. It is equipped with alternating pressers and has a clearance of 9/16 inch under the presser feet. Stitch regulation provides for stitches ranging in length from 2 to 8 to the inch. It is driven by a 1/2-hp. motor which operates on a 220-volt, 60-cycle, 3-phase current at 1,725 r.p.m. It has an arm clearance of 15-7/8 inches and a bed length of 25-1/4 inches. A complete unit consists of a machine head, a table, and a stand.

SHEARS, PINKING.—Used for finishing seams after stitching. Shears make a zigzag cut which prevents fraying.

SIZE.--Any of various glutinous materials, as preparations of glue or flour, used for filling the pores in the surface of paper, fiber, plaster, cloth, etc., or in bookbinding for applying color, gold leaf, or the like to book covers.

SNAP.--Hardware used in conjunction with the triangle link to secure the harness. This snap has no sliding bar and is used in the chest strap.

SNAP, QUICK CONNECTOR.--Hardware used in conjunction with the D-ring for attaching the chest type parachute pack to the harness.

SNAP, QUICK FIT.--Hardware used in conjunction with the triangle link to secure the harness. This snap is designed with a sliding bar for adjustment and is used in the leg straps.

STIFFENER, PACK.--Flat piece of fibrous material used to stiffen cloth flaps.

STITCH, ZIGZAG.--A lockstitch; the stitches being zigzag across the centerline of stitches. The double zigzag stitch strikes in the centerline as well as on either side of it.

STRAP, CROSS-CONNECTOR.--A "safety strap"; a short length of webbing sewed across a lift web assembly. This webbing is designed to prevent a "streamer" if only one side of the lift web assembly is engaged in the harness.

STRENGTH, TENSILE.--The greatest longitudinal stress a substance can bear without tearing.

TABLE, SEWING MACHINE.--The table acts as the stand for the head of the machine and the other parts which make up the entire assembly.

TACKING, BUTTERFLY.--Break tacking used to secure lift web assembly in chest type parachute pack.

TAPE.--A narrow woven ribbon of cotton, linen, or nylon.

TEST, BURST.--A method of testing material by applying pressure on the flat surface of fabrics until they actually burst.

TEST, DROP.--Testing a parachute by dropping it attached to a torso-shaped dummy.

THREAD.--A thin, continuous filament. One made by spinning the fibers of cotton, flax, silk, etc., and combining the strands so produced. Nylon thread is very elastic and is used exclusively on the nylon materials of the parachute.

THREAD, S TWIST.--If spirals of twists incline downward in a right-hand direction, thread has an S twist. Opposite of Z twist.

THREAD, Z TWIST.--If spirals of twists incline downward in a left hand direction, thread has a Z twist. Opposite of S twist.

TIE, BREAK.--Any tie or tacking designed to break under a specified amount of stress.

TRANSMITTER, ELECTRIC (SINGER).--The electric transmitter consists of a motor, flywheel, and clutch arrangement, which, when secured to the table and stand of a Singer Sewing Machine will provide the necessary smooth power for operation.

UNIT, CHEST PARACHUTE.--Refers to the chest pack, canopy, lift web assembly and all appendages connected with the pack. This does not include the harness.

UPRISE, SEWING MACHINE.--The uprise is the upright part of the head (generally located on the right side of the head) that houses a portion of the moving parts that transmit motion through mechanical shafts and linkages to the mechanisms in the base of the machine.

VELOCITY, TERMINAL, OF A FREE-FALLING BODY.--The greatest speed at which a body falls through the atmosphere (14.7 p.s.i.). Resistance of the air overcoming the pull of gravity establishes the approximate figure of 176 feet per second or 120 m.p.h.

WAX.--A substance secreted by bees for constructing the honeycomb; beeswax. It is a dull-yellow solid of agreeable odor, plastic when warm, and melting at about 143° - 151° F.

WEAVE.--The forming of a textile by interlacing yarns. The making or manufacturing of cloth on a loom by interlacing warp and filling yarns. The methods or patterns of weaving are PLAIN or TAFFETA weave, in which the threads are interlaced alternately; BASKET weave, in which double threads are interlaced as in plain weave; SATIN weave, in which warp threads interlace with filling threads at points distributed over the surface, thereby producing a smooth faced fabric; and TWILL weave, in which the filling threads pass over one and under two or more warp threads thereby giving an appearance of diagonal lines, or ribs.

WEBBING.--A stout, close-woven tape used for straps, belts, harnesses, etc.

WEBBING, PILOT CHUTE TIE.--Webbing used to tie the pilot chute to the main canopy.

APPENDIX II

ANSWERS TO QUIZZES

Chapter 1

THE PARACHUTE RIGGER RATING

1. b.
2. a.
3. b.
4. d.
5. c.
6. b.
7. c.
8. a.
9. c.
10. a.

Chapter 2

PARACHUTE FAMILIARIZATION

1. a.
2. c.
3. a.
4. c.
5. a.
6. a.
7. a.
8. c.
9. c.
10. a.
11. a.
12. b.
13. c.
14. a.
15. b.
16. b.
17. b.
18. a.
19. c.
20. c.
21. b.
22. c.
23. b.

Chapter 3

PARACHUTE INSPECTION

1. b.
2. d.
3. c.
4. a.
5. c.
6. b.
7. b.
8. d.
9. c.
10. d.
11. b.
12. a.
13. a.
14. c.
15. c.
16. d.
17. b.
18. d.
19. d.
20. d.
21. c.
22. c.
23. a.
24. d.
25. c.

Chapter 4

PARACHUTE PACKING AND RIGGING

1. b.
2. d.
3. a.
4. c.
5. c.
6. b.
7. b.
8. a.
9. c.
10. c.
11. d.
12. a.
13. c.
14. b.
15. b.

Chapter 5

PACKING AND RIGGING THE CHEST TYPE PARACHUTE

1. c.
2. c.
3. a.
4. d.
5. b.
6. d.
7. c.
8. c.
9. b.
10. a.
11. c.
12. d.
13. b.
14. d.
15. c.
16. b.
17. c.
18. b.
19. d.
20. a.

Chapter 6

PACKING AND RIGGING SEAT TYPE PARACHUTES

1. c.
2. d.
3. d.
4. b.
5. c.
6. b.
7. a.
8. d.
9. c.
10. b.
11. c.
12. a.
13. c.
14. d.
15. d.
16. d.
17. d.
18. c.
19. d.
20. b.
21. b.
22. b.
23. b.
24. c.
25. c.

Chapter 7

PACKING AND RIGGING BACK TYPE PARACHUTES

1. c.
2. d.
3. c.
4. b.
5. b.
6. d.
7. c.
8. d.
9. c.
10. a.
11. a.
12. b.
13. c.
14. b.
15. a.
16. c.
17. a.
18. c.
19. c.
20. a.

Chapter 8

PACKING AND RIGGING THE MARTIN-BAKER PARACHUTE

1. a.
2. b.
3. b.
4. b.
5. d.
6. a.
7. c.
8. d.
9. a.
10. c.
11. c.
12. c.
13. c.
14. d.
15. b.
16. b.
17. b.
18. b.
19. a.
20. a.
21. d.
22. a.
23. c.
24. b.
25. d.

Chapter 9

PACKING AND RIGGING THE RAPEC PARACHUTE

1. b.
2. c.
3. a.
4. c.
5. b.
6. b.
7. c.
8. b.
9. b.
10. a.
11. c.
12. a.
13. b.
14. d.
15. c.

Chapter 10

AUTOMATIC PARACHUTE ACTUATORS

1. c.
2. d.
3. a.
4. b.
5. a.
6. c.
7. a.
8. c.
9. b.
10. c.
11. b.
12. d.
13. a.

Chapter 11

SEWING MACHINE OPERATION AND LUBRICATION

1. b.
2. c.
3. b.
4. b.
5. a.
6. b.
7. b.
8. c.
9. b.
10. c.
11. b.
12. d.
13. b
14. b.
15. b.
16. b.
17. a.
18. d.
19. d.
20. b.
21. c.
22. a.
23. c.
24. d.
25. a.

Chapter 12

PARACHUTE MAINTENANCE AND REPAIRS

1. b.
2. a.
3. c.
4. c.
5. c.
6. d.
7. c.
8. a.
9. c.
10. a.
11. d.
12. b.
13. b.
14. b.
15. b.
16. b.
17. b.
18. d.
19. b.
20. b.
21. a.
22. b.
23. b.
24. b.
25. d.

Chapter 13

FASTENERS

1. d.
2. b.
3. b.
4. d.
5. d.
6. a.
7. d.
8. c.
9. d.
10. d.

Chapter 14

PROTECTIVE HELMETS AND OXYGEN MASKS

1. c.
2. b.
3. c.
4. b.
5. a.
6. a.
7. d.
8. b.
9. b.
10. a.
11. a.
12. b.
13. c.
14. d.
15. c.
16. c.
17. b.
18. d.
19. b.
20. c.

Chapter 15

FLIGHT CLOTHING AND PROTECTIVE EQUIPMENT

1. c.
2. d.
3. a.
4. a.
5. d.
6. d.
7. c.
8. a.
9. d.
10. d.
11. d.
12. b.
13. d.
14. d.
15. a.
16. b.
17. a.
18. d.
19. c.
20. b.
21. b.
22. c.
23. c.
24. a.

Chapter 16

STANDARD LIFE RAFTS AND EQUIPMENT

1. c.
2. c.
3. d.
4. c.
5. d.
6. d.
7. c.
8. d.
9. c.
10. a.
11. d.
12. b.
13. c.
14. b.
15. d.
16. c.
17. d.
18. c.
19. b.
20. c.
21. c.
22. c.
23. c.

Chapter 17

RECHARGING CARBON DIOXIDE CYLINDERS

1. c.
2. a.
3. d.
4. b.
5. a.
6. d.
7. d.
8. a.
9. d.
10. c.
11. c.
12. d.
13. d.
14. c.
15. c.

Chapter 18

SAFETY BELTS AND SHOULDER HARNESSES

1. d.
2. c.
3. a.
4. c.
5. d.
6. a.
7. d.
8. a.
9. c.
10. d.
11. b.
12. c.
13. d.
14. b.
15. c.
16. b.
17. c.
18. d.
19. c.
20. d.
21. a.
22. c.
23. d.
24. d.
25. a.

APPENDIX III

QUALIFICATIONS FOR ADVANCEMENT IN RATING

PARACHUTE RIGGER (PR)

(Through Change 16)

GENERAL RATING

SCOPE

Parachute Riggers: Inspect, maintain, and repair parachutes, survival equipment, and flight and protective clothing and equipment; pack and rig parachutes; pack and equip liferafts; repair and test oxygen regulators and liquid oxygen converters removed from aircraft; fit and maintain oxygen masks, flight clothing, antiexposure suits and anti-G suits; test and service pressure suits; operate and maintain carbon dioxide and liquid and gaseous oxygen shop transfer and recharge equipment; operate sewing machines; test safety belts and shoulder harnesses removed from aircraft; and supervise operation of parachute lofts.

SERVICE RATINGS

None.

PATH OF ADVANCEMENT TO LIMITED DUTY OFFICER

Parachute Riggers advance to Limited Duty Officers, Aviation Operations.

NAVY ENLISTED CLASSIFICATION CODES

See Manual of Navy Enlisted Classifications, NavPers 15105-B.

QUALIFICATIONS FOR ADVANCEMENT IN RATING

1. Qualifications for advancement to a higher rate include the qualifications of the lower rate or rates in addition to those stated for the higher rate.
2. Practical factors will be completed before recommendation for participation in the advancement examination. (Bureau of Naval Personnel Manual, NavPers 15791-A, Articles B--2326 and C--7201.)
3. Knowledge factors and knowledge aspects of practical factors will form the basis for questions in the written advancement examination.

Qualifications for Advancement in Rating	Applicable Rates
	PR
A. SAFETY	
1.0 PRACTICAL FACTORS	
1. Observe safety precautions when working in parachute lofts and shops, handling oxygen and carbon dioxide, and operating sewing machines	3
2. Observe safety precautions in use, handling, and storage of flammable cements, solvents, and thinners	2
3. Observe safety precautions in use of oxygen shop transfer equipment and in handling liquid and gaseous oxygen	1
4. Inspect work areas, tools, and equipment to detect potentially hazardous and unsafe conditions and take appropriate corrective action	C
2.0 KNOWLEDGE FACTORS	
None.	
B. PARACHUTES	
1.0 PRACTICAL FACTORS	
1. Inspect and pack parachutes; attach and rig equipment, such as pararaft kits and oxygen bailout units; make entries on parachute record and history cards. (Martin-Baker ejection seat parachutes are removed and installed in aircraft by personnel in the AM rating and delivered to the parachute loft for repacking by personnel in the PR rating.)	3
2. Unpack, wash, and dry parachutes	3
3. Identify stains and deterioration of parachute material	3
4. Make minor repairs to parachutes and component parts	3
5. Instruct plane captains, pilots, and aircrewmen in proper care, handling, and stowage of parachutes	2
6. Test and adjust automatic parachute actuators	2
7. Measure temperature and humidity in parachute dry lockers and storage rooms	1
8. Instruct in the procedures for parachute landings in high winds, trees, and water	C
9. Demonstrate aircraft emergency escape procedures and use of parachutes under simulated conditions	C
2.0 KNOWLEDGE FACTORS	
1. General arrangement and facilities of parachute lofts ashore and afloat	3
2. Types, component parts, construction, and operation of personnel parachutes	3
3. Types and operating principles of automatic parachute actuators	2

Qualifications for Advancement in Rating	Applicable Rates
	PR
2.0 KNOWLEDGE FACTORS—Continued	
4. Temperature and humidity limitations for parachute dry lockers and storage rooms	1
5. Purposes and operating principles of drogue, cargo, target drone, and other types of nonpersonnel parachutes	C
C. FABRIC WORK	
1.0 PRACTICAL FACTORS	
1. Hand sew, stitch, and tack material	3
2. Install and replace standard snap fasteners, grommets, slide fasteners, and speedy rivets	3
3. Inspect and proof load safety belts, automatic lapbelts, and shoulder harnesses removed from aircraft. (Safety belts, automatic lapbelts, and shoulder harnesses are removed and installed in aircraft by personnel in the AM rating.)	3
4. Operate standard sewing machines	3
5. Repair slide fasteners	2
6. Lubricate sewing machines and make minor adjustments	2
7. Cold patch and vulcanize rubberized material	2
8. Make fabric asemblies	2
9. Develop and lay out patterns from drawings, blueprints, and photographs	1
10. Determine causes of sewing malfunctions; repair and replace parts	C
2.0 KNOWLEDGE FACTORS	
1. Types and general characteristics of fabrics, tapes, webbings, fasteners, needles, thread, and other material used in fabric work	3
2. Types and uses of seams and stitching patterns	3
3. Operating principles of standard sewing machines	3
4. Types and application of fabric patches	2
5. Procedures for removing stains from fabric materials	2
6. Symbols and terms used on drawings and blueprints for fabric work	1
7. Specifications, characteristics, and uses of fabrics, tapes, webbings, thread, hardware, and other materials used in fabric work and allowable substitutes	C
D. FLIGHT AND PROTECTIVE CLOTHING AND EQUIPMENT	
1.0 PRACTICAL FACTORS	
1. Inspect and test lifevests and attached equipment	3
2. Inspect and clean oxygen masks	3
3. Remove and replace components of oxygen mask assemblies including mask-mounted oxygen regulators	3

Qualifications for Advancement in Rating	Applicable Rates
	PR
1.0 PRACTICAL FACTORS—Continued	
4. Prepare required records and reports of flight and protective clothing and equipment inspections and maintenance	3
5. Patch lifevests and antiexposure suits	2
6. Repair flight clothing	2
7. Fit integrated torso harness suits	2
8. Fit and repair antiexposure suits	2
9. Fit and adjust helmets and liners; install earphones and microphones. (Earphones and microphones are maintained by personnel in the AT rating.)	2
10. Fit and adjust anti-G suits. (Anti-G systems, except the suit, are maintained by personnel in the AM rating.)	1
11. Operate portable pressure suit leakage test kits; test pressure suits and related components. (Full and partial pressure suits are fitted under the direction of flight surgeons and aviation physiology training units.)	1
12. Fit and modify oxygen masks	C
13. Demonstrate use of flight and protective clothing and equipment under simulated conditions	C
2.0 KNOWLEDGE FACTORS	
1. Use and application of fire retardant compounds for flight clothing	2
2. Regulations governing changes and repairs to flight and protective clothing and equipment	2
3. Components and principles of operation of full pressure suits	1
E. SURVIVAL EQUIPMENT	
1.0 PRACTICAL FACTORS	
1. Inspect, test, equip, and pack liferafts; replace carbon dioxide cylinders. (Liferaft ejection systems in aircraft are maintained by personnel in the AM rating. Emergency radio signaling units are delivered to the electronic shop for maintenance or exchange by personnel in the AT rating.)	3
2. Operate carbon dioxide recharge equipment	3
3. Patch holes and tears in liferafts	2
4. Demonstrate use of liferafts and equipment.	2
5. Maintain carbon dioxide recharge equipment	1
6. Assemble, pack, and rig airdrop survival kits and containers.	C
2.0 KNOWLEDGE FACTORS	
1. Types, construction, and operation of liferafts.	3
2. Principles of operation of carbon dioxide cylinder components used in liferafts.	2

Qualifications for Advancement in Rating	Applicable Rates
	PR
2.0 KNOWLEDGE FACTORS—Continued	
3. Construction of various types of liftwebs and sling assemblies for use on cargo to be dropped with aerial delivery parachutes	C
F. OXYGEN EQUIPMENT	
1.0 PRACTICAL FACTORS	
1. Operate and maintain liquid and gaseous oxygen shop transfer equipment. (Personnel in the AM rating service, handle, and maintain liquid and gaseous oxygen transfer trailers.)	1
2. Shop test aircraft liquid oxygen converters; repair or replace components as necessary. (Converters are removed and installed in aircraft by personnel in the AM rating and delivered to the oxygen shop for test, repair, or exchange.)	1
3. Test oxygen for contamination, using water vapor indicators, halide detectors, and purity analyzers .	1
4. Test and repair oxygen regulators. (Includes mask-mounted, aircraft-mounted, and pressure-suit regulators. Aircraft-mounted regulators are removed and installed in aircraft by personnel in the AM rating and delivered to the oxygen regulator shop for test, repair, or exhange.).	1
5. Prepare appropriate calibration and flow charts for testing oxygen regulators and liquid oxygen converters	C
6. Maintain oxygen regulator test stands and liquid oxygen converter test stands	C
2.0 KNOWLEDGE FACTORS	
None.	
G. ADMINISTRATION	
1.0 PRACTICAL FACTORS	
1. Inventory and order equipment, spare parts, and material	1
2. Maintain current loft and shop files of applicable technical publications, directives and manuals. . . .	1
3. Prepare reports of test and repair of oxygen regulators.	1
4. Maintain loft and shop records of packing, inspection, test, and repair of equipment and material; prepare appropriate reports.	1
5. Use NAVAER Publications Index to identify and order technical publications, directives, and manuals	1
6. Organize and administer a parachute loft	C
7. Plan, schedule, and direct work assignments in a parachute loft	C

Qualifications for Advancement in Rating	Applicable Rates
	PR
1.0 PRACTICAL FACTORS—Continued	
8. Interpret and apply bulletins and technical directives	C
9. Prepare reports for survey of material and equipment	C
10. Instruct and supervise personnel in use of parachute loft equipment and facilities and maintenance techniques; maintain quality control of work performed	C
11. Prepare for advanced-base or forward-area operation by estimating material, equipment, and manpower requirements	C
2.0 KNOWLEDGE FACTORS	
None.	

INDEX

Acid damage, 290-291
Actuators, automatic parachute
    Irvin Mk V, 247
    Master Specialties, 253
Advancement, studying for, 3-5
Antiexposure suits, 356-363
Anti-g suits, 355
Assignments for PR3 and PR2, 5-6
Automatic parachute actuators:
    Irvin Mk V, 247
    Master Specialties, 253

Backstitch, 347
Back type parachutes:
    NB-3, 152
    NB-6 and 8, 157
Bailout cylinder, 125
Barometric Release, Mk V, 247
Belts, safety, 432-443
    description, 432
    inspection, 436
    installation, 441
    types:
        automatic release type, 433
        crewman's, 434
        gunner's, 435
    testing, 436
Bobbin:
    removing, 264, 270, 276, 280
    replacing, 267, 270, 273, 277
    winding, 266, 270, 277, 280
Boots, pilot's, 359-361
Butterfly tacking, 74
Buttonholes, 348-349

Canopy:
    chart, 49
    conical, 19
    flat, 17
    patching of, 299-301
Catch stitching, 347
Cementing, 360, 395-397
Chafing bags, 64
Chaining, 62
Chest type parachute:
    description of, 10-11
    packing and rigging, 69-119
Clothing, flight, 344-350
    maintenance, 346
    types, 344-346
CO_2 recharge equipment, 418-423
    C-O-TWO Unit, 418-420
    Kidde Unit, 420-423
Containers:
    inspection of, 44
    parachute seat, 23
    reinforcing, 303

Contamination:
    acid, 290
    dew, 292
    mildew and fungus, 292
    perspiration, 292
    pond water, 291
    rain, 292
    river or lake, 291
    salt water, 292
Cord, nylon, 289
Corner reflector, 384
Coverall, quick donning, 362
Cushions, seat, 25

Darning, 346
Desalting kit, 387
Directives, noncompliance, 38
Disposition of repairs, 47
Distress signals, 391
Double needle stitch, 348
Double patching, 300
Drogue parachutes, 177
Drying parachutes, 58
Dry locker procedure, 62-63
Dye markers, 386

Emergency Signal Code, 101, 387
Enlisted Correspondence Courses, 4
Enlisted rating structure, 1
Entanglements:
    suspension line, 55
    removal methods, 56

Fabric materials:
    damages to, 290-292
    types of, 289
Fastener kit, 307
Fasteners:
    slide, 311-319
        construction, 311
        installation, 316-319
        operation, 311
        procurement, 318
        repairs, 313
        tools, 313
    snap, 306-311
        installation, 307
        removal, 310
        setting tools
        types of, 306
Feed dog, 262-263
Flight clothing. (See Clothing.)
Fungus growth, 292

Grommets, 304, 309-310
Guide tube, 168

Handling packed parachutes, 63-66
Hand sewing, 346-348
Hardware, harness, 25, 33-35
Harness, parachute:
    back type, 25
    chest type, 26
    conventional, 21
    dumping, 118
    oversize, 21
    quick-fit, 114
    RAPEC, 14
Harness, shoulder, 432
Helmets, protective, 321-329
    types:
        APH-5, 324
        H-3, 321
        H-4, 323
        S/PH-1, 327
Hemming, 347
History of parachutes, 7
Holding stand, Martin-Baker, 203
Housings, ripcord, 25

Indicator, stitch, 286
Inertia reel, 434
Inspection of parachutes:
    back pads, 45
    canopy, 40, 47
    container, 44
    deterioration, 37
    discontinuity of suspension lines, 37
    flaws, 38
    harness, 43
    periodic, 38-39
    pilot chute, 39
    ripcords, 43, 45
    seat cushions, 45
Inspection report, 50
Irvin Barometric Release, 247
    installation, 248
    maintenance, 249-250
    operation, 247
    troubleshooting, 251-252

Knots, 63-64

Leakage test, A-13A mask hose, 335
Live preservers, 370-375
Life raft equipment:
    accessories, 382
    bailing sponge, 381
    carrying case, 382
    compass, 384
    corner reflector, 384
    desalting kit, 387
    dye marker, 386
    first aid kit, 391
    hammock bed, 383
    handpump, 381
    lifeline, 379
    mast holder, 378
    mirror, 383
    oarlocks, 378
    oars, 380
    sea anchor, 383
    solar still, 389
    supply pocket, 379
    water bags, 385
    whistle, 381
Life raft inflation equipment, 423-430
Life rafts, 377-415
    boarding, 415
    demonstrating use of, 414
    inflating, 414
    inspecting, 393, 405, 407, 413
    maintenance and repair, 395-401
    packing, 411-414
    survey, 395
    types,
        AR-4, 407
        Mk 12 and Mk 20, 409-414
        multiplace, 377-393
        pararaft, 401-407
Life vests, 363
Lines, suspension:
    removing entaglements, 56
    stowing of, 156
Liquid oxygen, precatuions with, 341
Litmus paper, 290
Lockstitch, 261

Martin-Baker parachute:
    description, 177
    drogues, 177-181
    packing and rigging, 181-216
        arranging harness, 190
        holding stand, 203
Masks, oxygen, 329-339
    A-13A, 330-338
        construction, 330
        microphone installation, 331
        operation, 332
        testing, 334
    demand (A-14):
        cleaning, 339
        description, 338
Master Specialties Actuator, 253-259
    installation, 254-256
    maintenance, 256
    operation, 253
    troubleshooting, 257-258
Microphone, ANB-M-C1, 331
Mildew, 292
Mirror, signaling, 383

Navy Training Courses, types, 3-4
Needles, sewing, 53-54
Nylon parachute cloth, 289
Nylon tubular webbing, 290

Ointment, sunburn, 392
Open purchase, 307
Oxygen masks, 329-339
Oxygen regulators, 339

Oxygen safety precautions, 340

Pack:
  back, 29
  chest, 28
  seat, 27
Packing and rigging:
  back type, 152-176
    adjustments, 153
    without pararaft, 152
    with pararaft, 157
  chest type, 69-119
  general information, 53-68
  hand tools, 55-57
  Martin-Baker, 177-214
  NB-9, 217-246
  RAPEC, 217-246
  seat type, 120-149
  troop type, 158, 174-175
Parachute:
  canopy, 17-19
  containers, 23
  design and construction, 8-10
  drying, 58
  familiarization, 7
  handling, 63-66
  history of, 7-8
  inspection, 37
  maintenance, 299-301
  packing and rigging:
    Martin-Baker, 181-216
    NB-6 and NB-8, 152
    NB-9, 217-246
    NC-3, 69-114
    NS-3, 120-150
    NT-5, 158, 174-175
    RAPEC, 217-246
  principles of operation, 8-10
  repairs, 299-301
  survey, 51
  types of, 10-17
Parachute actuators:
  Irvin Mk V, 247
  Master Specialties, 253
Parachute bag, constructing, 304
Parachute cleaning, 292
Parachute History Card, 130
Parachute inspection, 37-52
  deterioration, 37
  discontinuity of suspension lines, 37
  flaws, 38
  main canopy, 47
Parachute Inspection Card, 190
Parachute maintenance and repairs:
  cleaning, 292-296
  patching, 299-301
  replacing components, 301
Parachute Record Card, 114, 173, 228, 231
Parachute Rigger School, 3
Pararaft, 70, 121
Patching, 299-301
Paulin, life raft, 389
Pilot chute:
  description of, 17
  replacing, 302
  vane type, 218
Preservers, life, 370-375
Pressure suit, 350
Protective equipment, 350-374
  antiexposure suits, 356-363
  anti-g suits, 355
  helmets, 321-329
  full pressure suit, 350
  life vests, 363
  preservers, 370
  torso harness suit, 353
PR rating, scope of, 2

Quick-fit harness, 114-118

RAPEC parachute, 217-246
Ratings, types of, 1
Record Card, Parachute, 85, 101, 114
Record of Practical Factors, 2
Reel, inertia, 434, 438
Regulator, oxygen, 339
Rigging NS-3 parachute, 120-126
  attaching ripcord housing, 125
  attaching seat cushion, 121
  removing connector links, 120
  with bailout cylinder, 125
  with pararaft, 121
Rigging tools, 53
Ring, parachute harness, 33
Ripcord grips, 30-32
Ripcords, description of, 23
Rivets, speedy, 310
Running stitch, 346

Safety belts, 432-443
Safety precautions:
  oxygen, 340
  parachute, 66-67
Safety tie, ripcord locking pins, 112
Sea anchor, 383
Seams and stitches, 295-299
Seat cushions, inspection of, 45
Setting tools, 307
Sewing machines, 260-286
  class 7-33, 269-273
    description, 269
    lubrication, 270-271
    threading, 270, 272
  class 31-15, 262-269
    description, 262
    lubrication, 262, 265
    operation, 262-264
    regulating tension, 268
    threading, 266
  class 111, 274-279
    lubrication, 275-277
    operation, 276-279
    regulating, 278
  class 112, 279-281

Sewing machines--Continued
    class 143, 281-286
    operation, 260
    types:
        oscillating, 262
        rotary, 274
Shipping cans, 66
Shoulder harness, 432
Signaling mirror, 383
Signals, distress, 391
Slide fasteners, 311-319
Snap fasteners, 306-311
Snap release, Capewell, 34
Snaps, 34
Solar still, 389
Speedy rivets, 310
Stain removal, 293-295, 349
Stenciling, parachutes and components, 293-294
Stitch, baseball, 300
Stitches and seams, 295-299
Stitch, regulating length of, 269, 272, 27
Survey, parachutes, 51
Suspension lines:
    description, 20
    entanglements, 55-58
    inspection of, 42-43

Table, inspection, 39
Tacking NS-3 pack, 125-133
Template, NB-9 parachute, 245
Tensile strengths, 46
Testing equipment (safety belt), 438
Thread, 190, 228
Torso harness suit, 353
Transfer, parachutes, 51

Vent ring, replacing, 301
Vests, life, 363

Zippers, 311-319

USPA

14 DAY USE
RETURN TO DESK FROM WHICH BORROWED

LOAN DEPT.

This book is due on the last date stamped below, or
on the date to which renewed.
Renewed books are subject to immediate recall.

28Mar'62SL
REC'D LD
REC'D LD
NOV 3 '64-1 PM
APR 9 1962
30Ap'62JM
NOV 11 1966 15
RECEIVED
REC'D LD NOV 11 '66-8 PM
APR 23 1962
LOAN DEPT.
7Feb'63DB
OCT 10 1968 83
REC'D LD
OCT 9 '68-3 PM
REC'D LD
FEB 4 1963
JAN 22 1969 37
RECEIVED
4Nov'64
JAN 22'69-11 AM

LD 21A-50m-8,'61
(C1795s10)476B
General Library
University of California
Berkeley
LOAN DEPT.

YE 15707